Perception, Identity, Territory:

Social Dimensions of Climate Change Adaptation in Northern Norway

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Abstract

It is often contended that individuals and states fail to act on knowledge of climate change as it is too abstract and intangible. What then of the so-called “hotspot” communities situated in the most dramatically impacted regions on the frontlines of climate change? This project aims to identify a community particularly exposed to climate change and to answer whether or not changes here occur at a sufficient magnitude to be perceived and if so, to what degree are its inhabitants responding? Qualitative, ground-up, sector-based research conducted in one such hotspot, Arctic Norway, found that 1) environmental changes are indeed being perceived and acted upon by local inhabitants, though with varying degrees across industries 2) that social identities relating to livelihoods serve as both enablers and limitations to adaptation and 3) that overlapping territorial claims/needs significantly limit current and future adaptation possibilities.

Key Words: Social limitations and enablers to adaptation, vulnerability, climate change, livelihoods, Hammerfest, Finnmark, Norway, fisheries, LNG, reindeer herding, tourism, mining, perception, identity, territory.

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Abbreviations

AMAP	Arctic Monitoring and Assessment Programme
CAFF	Conservation of Arctic Flora and Fauna
CBA	Community-based approach
CBD	Convention on Biological Diversity
EEZ	Exclusive economic zone
EPA	Environmental Protection Agency
GHG	Greenhouse gas
GIS	Geographic Information System
IPCC	Intergovernmental Panel on Climate Change
LECZ	Low elevation coastal zone
LNG	Liquefied natural gas
NPI	Norwegian Polar Institute
SSB	Statistics Norway (Statistisk Sentralbyrå)
STD	Submarine tailings deposit
TEK	Traditional ecological knowledge
UNESCO	United Nations Educational, Scientific and Cultural Organization

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Finally, I would like to thank the interviewees who made this research possible. I consider myself fortunate for gaining a brief glance into their world, one which will certainly continue to intrigue me for years to come. The beauty of the North is equaled by the beauty of its people.

Maps

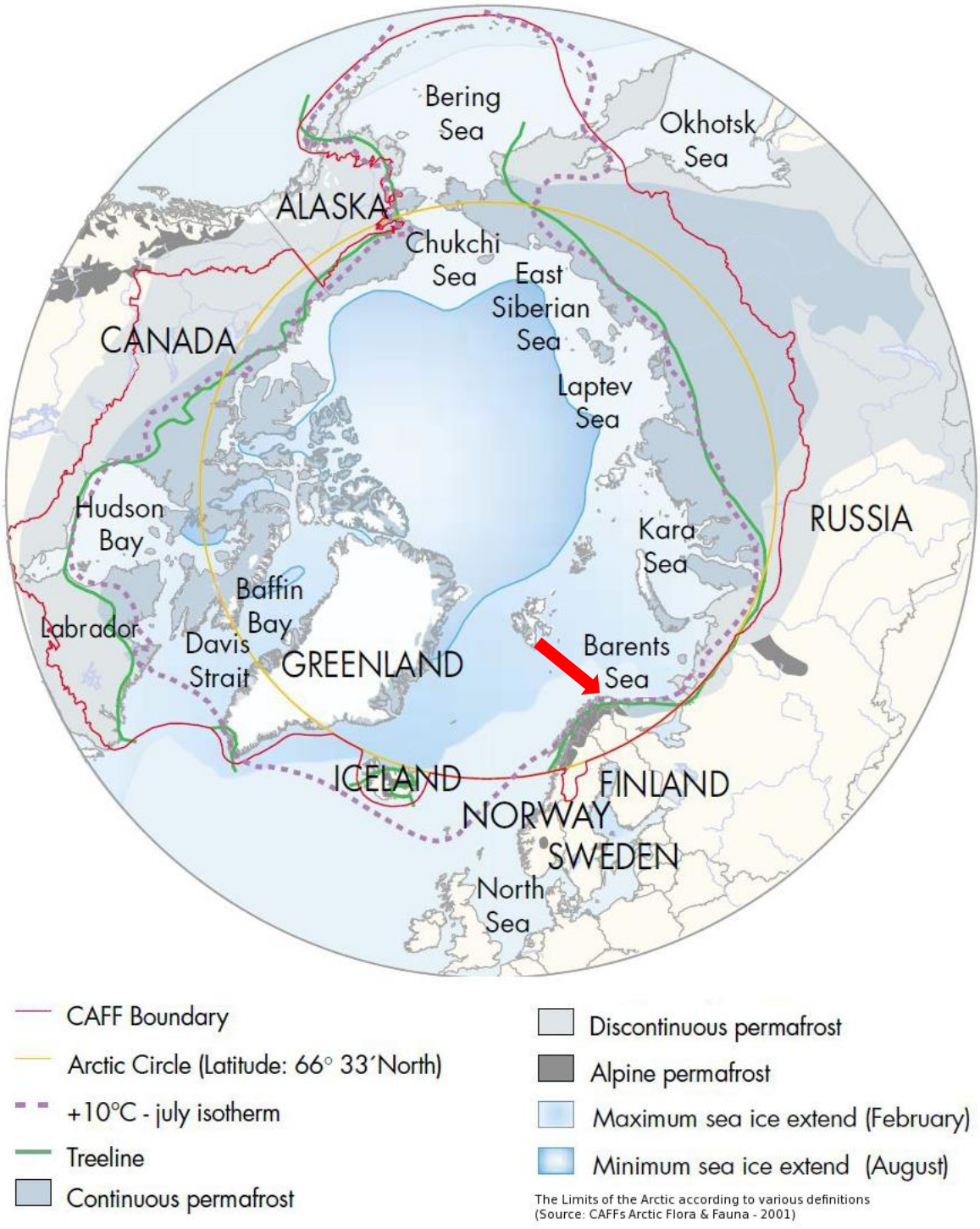


Figure 1 - Arctic Map (Arctic Council, 2001)

The 'Arctic' has numerous definitions. Even within the different working groups of the Arctic Council (e.g. CAFF) there are numerous different definitions depending on the focus of its activities. An arrow (inserted by author) shows the case study location, within the boundaries of all commonly used definitions of the Arctic.

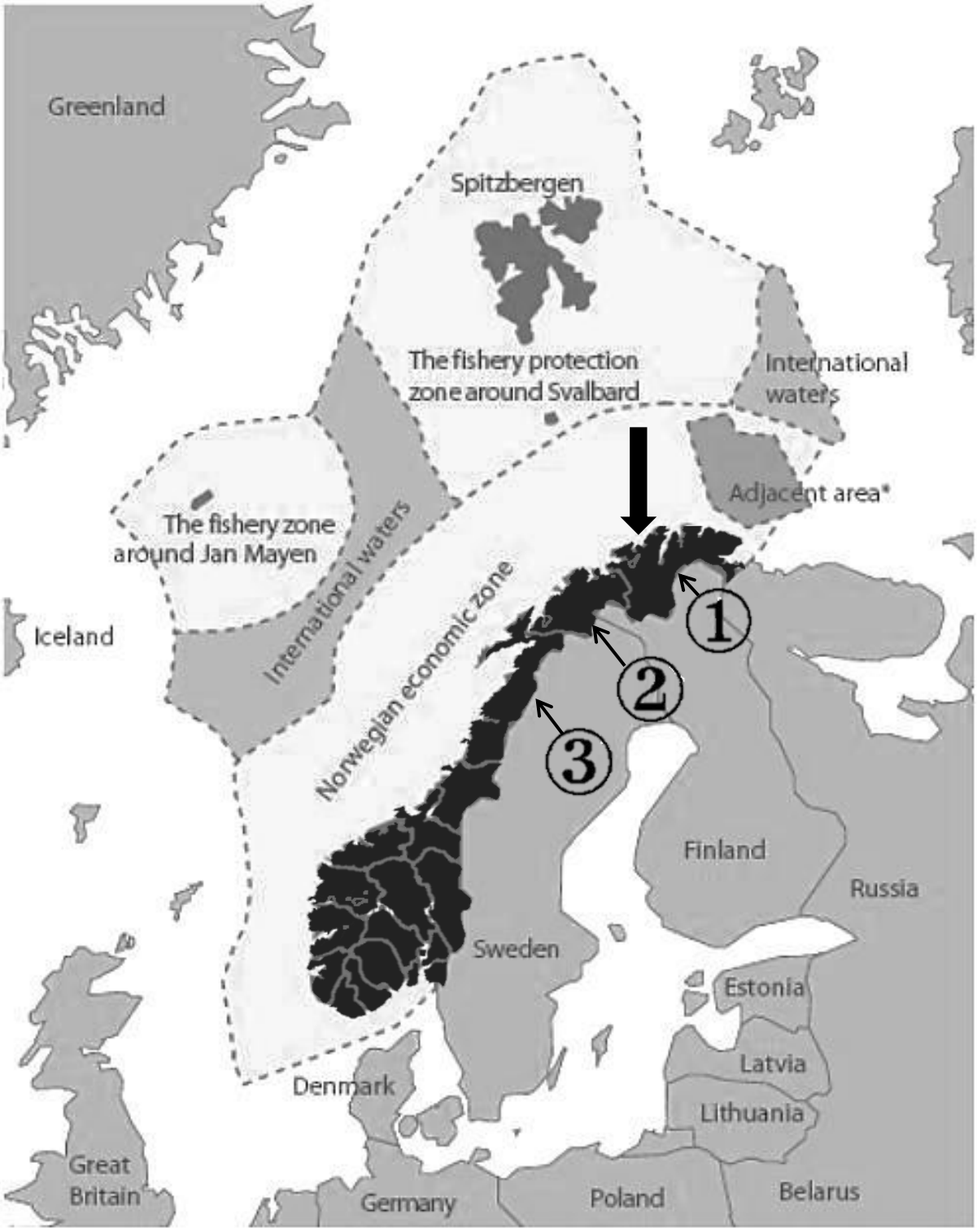


Figure 2 - Norwegian Exclusive Economic Zone and Fishery Zones. (FAO, 2015)

An arrow shows the case study location of Hammerfest, and the counties referred to in this study are identified: 1) Finnmark County 2) Troms County 3) Nordland County (numbering, county boundaries and arrow inserted by author)

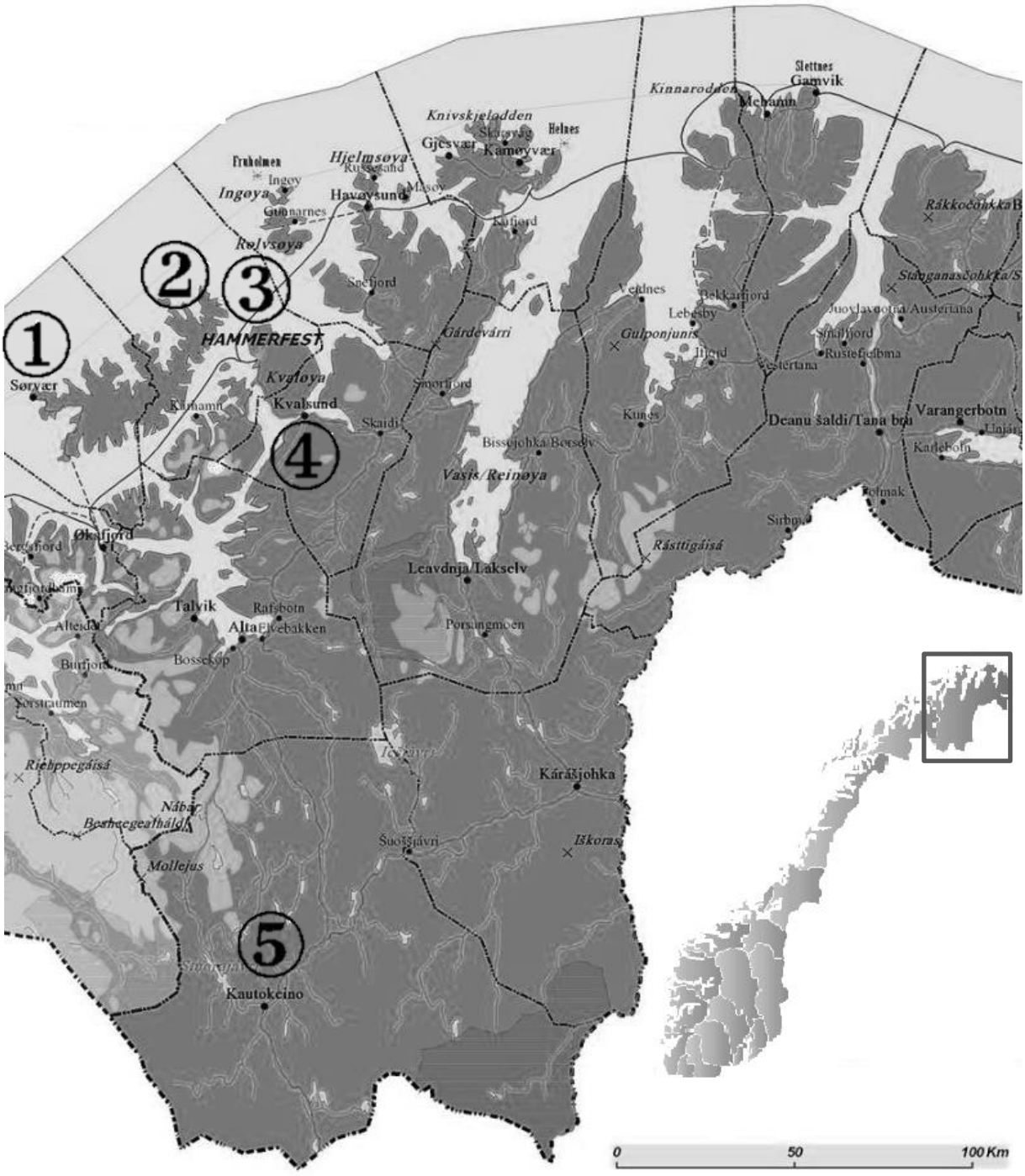


Figure 3 - Map of Finnmark (Jensens, 2008)

1) Sørvær: Fisheries respondent location 2) Akkarfjord: Field work location on Sørøya, 3) Hammerfest: Primary field work location 4) Kvalsund: Field work location and proposed location of Nussir mine 5) Kautekeino: Herder respondent location and winter grazing area for reindeer herder respondents. (Norway overview map and numbers inserted by author)

1 Introduction

It is often contended that individuals and states fail to act on knowledge of climate change as it is too abstract and intangible.[1] Indeed, without historical data or technical instruments compensating for our tangible senses, for most people the changes that can be attributed to climate change are imperceptible. Yet a growing consensus in the scientific community has found the rates and magnitude of many of these same changes are unprecedented in human history, raising the alarm that adaptive and mitigative action must be taken immediately if we are to avoid the worst of climate change's potential impacts (IPCC 2013). What is left is a general sense of powerlessness as we, though equipped with knowledge of impending calamity, lack the experience or any form of instruction manual on how to face what may prove the greatest challenge of our time. What then of the so-called 'hotspot' communities situated in the most dramatically impacted regions on the frontlines of climate change? Is climate change here too just an abstraction?

Research Question: This project aims to identify a community particularly exposed to climate change impacts and to determine whether or not changes here are perceived and if so, are its inhabitants responding?

Sub-question: To what degree does identity and territory act as social limitations and enablers to adaptation in an especially vulnerable community?

Using qualitative, ground-up, sector-based research conducted in one such hotspot, Arctic Norway, I found that 1) environmental changes are indeed being perceived and acted upon by local inhabitants, though with varying degrees across industries 2) that social identities relating to livelihoods serve as both enablers and limitations to adaptation and 3) that saturated and overlapping territorial claims/needs significantly limit current and future adaptation possibilities. The unique experiences of individuals in the present case study and other such hotspots may be useful in providing lessons which inform climate change adaptation policies as more and more communities face similar challenges.

[1] e.g. Giddens 2009, Postel 2015, New York Times 2014

1.1 Thesis Structure

This thesis consists of 6 chapters, which will be organized as follows: Chapter 2 'Theoretical Approach' will provide the theoretical basis for the analysis. It presents a brief introduction to social constructivism theory, and goes on to identify and define the key terms of *vulnerability* and *adaptation*. Chapter 3 'Methods' presents the methodological approach and details the methods employed. The rationale behind the choice of each method, their strengths and limitations, as well as ethical considerations, will be examined. Chapter 4 'Key Findings' will present the themes of Perception, Identity and Territory which were identified as key issues from the primary data, and the key findings relating to these themes. In Chapter 5 'Discussion', these 3 themes will be cross-examined using relevant secondary data sources. The discussion of each theme is conducted in a manner which is intended to synthesize both the findings from the primary data as well as the relevant secondary sources. The ensuing structure of each section follows a course I deemed appropriate to building my arguments around that particular theme; however, the three subsections of Chapter 5 do follow a red thread, whereby each theme is considered in relation to vulnerability and in its role as either a limiter or enabler of subsequent action/adaptation. Chapter 6 'Conclusion' demonstrates how the findings and discussion answered the research questions, identifies questions which require further research, and contains some final remarks.

1.2 Identifying a Hotspot

These are still early days when it comes to what climate change may have in store for us. As such, the study of adaptation based on current and unfolding environmental changes requires that we find just such a special case, a natural experiment of sorts, where changes are likely to be significant enough to register on social practices and individual perception and behavior.

Geographic areas which are particularly vulnerable and exposed to climate change are known as 'hotspots' and can refer either to simple ecological factors or both social and ecological systems, whereby the former includes implications on local inhabitants (IPCC 2013). In this sense, hotspots are largely synonymous with a community's vulnerability to climate change and are not necessarily related to the scale of climate change present or predicted.[2]

The most commonly referred to hotspots are found in the Arctic, Sub-Saharan Africa and the so-called Low Elevation Coastal Zones (LECZs), such as the highly populated mega-deltas of Asia and the islands of the South Pacific that face complete inundation. For the purposes of this study, the deltas of Asia and islands of the South Pacific would have made for adequate case studies. Indeed, the simplicity of sea level rise which can literally be observed from year to year as it claims more and more land could have provided interesting insights into perception and adaptation. Increasing storm severity may also have been registered by the local inhabitants. Similarly Sub-Saharan Africa with its increasing desertification.

In order to elucidate the challenges associated with adapting to the unprecidented impacts of climate change, an ideal case study would be one which is experiencing entirely novel changes. Yet in many ways the LECZs and Sub-Saharan communities are experiencing "more of the same," that is, day to day conditions that are common to these places. For example, recent sea-level rise acceleration is unique, and has seen a global increase of 17cm in the last 100 years. Yet this is part of an ongoing trend which

[2] e.g. Some places may experience greater degrees of temperature change, or be more exposed to the effects of sea level rise, but do not contain a vulnerable population. These do not constitute hotspots , in its common use.

has seen the oceans rise by 120 m since the last ice age 20 000 years ago (Vasskog et al. 2009). It is a phenomenon that only the most observant beach-goers may have noticed, and even then could be obscured by normal processes of coastal accretion and erosion. Similarly Sub-Saharan Africa has long been plagued by droughts and has likely established itself firmly into the memory of its inhabitants as 'normal,' or at least not unexpected. Though changes in these places may be dramatic, they are not unprecedented in recent human history.

The Scientific Basis for Arctic Climate Change

Numerous changes in the Arctic, however, are unprecedented in human history. If historical records and current observations are any indication, the Arctic is believed to be entering a "new era" (BBC 2015), and Arctic peoples are already having to adapt (AHDR 2004, as cited in Hovelsrud & Smit 2010: 1). While it remains outside the scope of this research project to provide a comprehensive list of climate change's impacts, three of the most dramatic changes unique to the Arctic will be briefly outlined below:

Atmospheric Temperature Increase: While the global average temperature increase since the industrial revolution has been around 0.6 °C, Arctic average temperatures have risen by twice this average, and in certain places more. Arctic winters in particular have seen an increase of 3-4 °C during the 20th century and are projected to rise by another 4 – 7 degrees by the end of the 21st century (ACIA 2004).

Ocean Acidification: The rate[3] of increase in ocean acidity is one of the most significant consequences of greenhouse gas (GHG) emissions, and has led to an ocean which is 26% more acidic than pre-industrial values (CBD 2014). Moreover, ocean acidification occurs most rapidly in the Arctic as cold water absorbs more CO2 than warm water (AMAP 2013). The IPCC estimates that by 2100, pH will be within the

[3] Between -0.0014 and -0.0024 pH units per year (IPCC 2013). Thomas Lovejoy, former chief biodiversity advisor to the World Bank, has suggested that "the acidity of the oceans will more than double in the next 40 years. This rate is 100 times faster than any changes in ocean acidity in the last 20 million years, making it unlikely that marine life can somehow adapt to the changes." (National Geographic 2009)

range of 7.75-7.95, compared to today's 8.1 (IPCC 2007). Ocean acidification[4] is one of the leading theories behind Earth's greatest extinction event 250 million years ago (the Great Permian Extinction) which killed off 96% of all marine species (Clarkson et al. 2015). Though ocean acidification's current effects remain somewhat of a mystery, its future impacts are projected to be similarly catastrophic if the process is not stopped (CBD 2014).[5] The current rate of acidification is 100 times faster than "any change in acidity experienced by marine organisms for at least the last 20 million years" (UNESCO 2015). As modern humans have only been around 200,000 years or so, we have never had to adapt to present, let alone projected conditions.

Sea Ice Loss: Like the rate of ocean acidification the rate of Arctic sea-ice loss is amongst the most dramatic impacts of global warming. The last three decades in particular have seen a retreat of the summer sea ice extent which is unprecedented in historical observations (IPCC 2013). The annual mean Arctic sea ice extent has experienced an area loss of between 3.5 to 4.1% per decade over the period of 1979 to 2012, and its summer ice extent has decreased between 9.4 – 13.6% per decade since 1979 (ibid: 9). The latter equates to a loss of between 0.73 to 1.07 million km² – or roughly three times the area of mainland Norway[6] - per decade (ibid: 9). Based on one model,[7] it is likely that mid-century may already see a nearly ice-free[8] Arctic ocean during late summer months (ibid: 25). It is estimated that the last time the Arctic saw ice-free summers was roughly 4 million years ago, predating the emergence of modern humans by 3.8 million years. Again, humanity has never before experienced such an event (Knies et al. 2014).

4 Recent research by Clarkson et al. (2015) suggests that the pH level dropped as low as 7.5.

5 CBD (2014), suggests that it took around 100,000 years for ocean ecosystems to recover following a similar acidification event 56 million years ago.

6 304,282 km², not including Svalbard, Jan Mayen, Bouvet Island or Norway's (unrecognized) claims in the Antarctic, Queen Maud Land and Peter I Land.

7 RCP8.5

8 Whereby 'nearly ice free' refers to 'when the sea ice extent is less than 106 km2 for at least five consecutive year.' (IPCC 2013: 25)

These changes have no parallel in recent human history and in a globalized, more populous world, will represent both challenges and opportunities in terms of human migration, economy, local ecosystems, traditional land claims and livelihoods to name a few. Due to its small population (4 million inhabitants) and the relative wealth of the eight Arctic nations[9], the Arctic may not top the lists of humanitarian crisis in the 21st century. Yet if even the moderate climate modelling projections are accurate, it may be unrecognizable in the near future.

The most northerly city in the world, Hammerfest, located in Finnmark County, Norway, was identified early on during the desk study as an appropriate case study and this research will endeavor to explore how its inhabitants are responding to these unique challenges.

1.3 Case Study Background

Over the course of the Arctic's not so recent history, Northern Norway has indeed experienced dramatic environmental change, and its inhabitants have had to make way. To put modern adaptation in perspective, a brief outline of Finnmark's climatic and human history will now be explored.

In the last 2.6 million years there have been roughly 40-50 ice ages. Prior to the outset of the last ice age (80,000 years ago), Neanderthals are believed to once have lived in what is today Scandinavia. Archeological evidence is scant, however, having been crushed and swept out to sea by the four kilometer thick sheet of ice that scoured Scandinavia down to its granite bedrock.

Human (*Homo sapiens*) archeological history in Arctic Norway begins as the ice began its retreat from the coasts around 11,500 BC. This barren, ice-scarred landscape was initially uninhabitable – for human and animal alike. Yet with warming temperatures, new opportunities for life arose. In time, plants such as lichen and moss began to establish on the bare rock, and provided an abundant source of food for various mammals including the reindeer. Human hunters were close behind, and are presumed to have followed these herds into Northern Scandinavia. There are numerous theories

9 Arctic Council member states: Canada, USA, Denmark, Iceland, Norway, Sweden, Finland and Russia.

as to who these initial inhabitants were. Were they Proto-Saami arriving from the northeast, Proto-Baltic from the east, or Proto-Germanic from the south? Whatever the case, it is remarkable that the remote northern coasts of Finnmark have some of the oldest archeological evidence for human habitation in the whole of Norway.

Following the last Ice Age, temperatures continued to rise until roughly 6,000 BC when average summer temperatures in Finnmark were a whole 3 degrees warmer than today's. Virtually all of Norway's glaciers were melted and the tree-line was 300 m higher than at present. By 1,000 BC settlers were farming barley in what is today neighboring Troms County. In general, the climate was surprisingly agreeable given its latitude and food was plenty.

Concrete evidence places the existence of Saami[10] culture in Finnmark at around the first century, though it is very likely that they were virtually its sole inhabitants long before and certainly long after. Indeed 'Finnmark' is derived from the Old Norse 'Finnmork' meaning 'land of the Saami.' The Saami had ties to the Norse[11] for centuries, with the former paying tributes to the latter in the form of reindeer skins. Remarkably, the Norse colonized both Greenland and America 300 years before moving northeast of today's Troms County in response to increasing international trade in dried cod (stockfish) which had become Norway's most important trade during the medieval age (Berge 1996, as cited in Hovelsrud & Smit 2010: 31). It was only then in the late stages of Norse colonization (1400 AD) that Finnmark acquired a more culturally heterogeneous population.

Following the warming period which reached its height in the Middle Ages, temperature generally decreased in Finnmark leading to the Little Ice Age (1500-1800 AD). This cooling period witnessed the drastic out-migration of the Norse from mainland

[10] Scandinavia's only recognized indigenous people. Originally nomads from the east, who practice reindeer pastoralism, fishing to this day.

[11] Norse (or *Norrøn*) is the term used today for the Nordic ethnic group (and their language) occupying western Scandinavia and Iceland during the Viking Age between 700-1350.

Finnmark, along with the abandonment of both their Greenland and American colonies.[12]

The end of the Little Ice Age brings us into the modern era, characterized by numerous global societal, environmental and climatic changes that have been accelerating over the last few decades. Many of these changes are occurring most rapidly in the Arctic, sometimes at rates doubling the global average.

Modern Environmental Change

The Norwegian Polar Institute (NPI) in their report "Climate Change in the Norwegian Arctic: Consequences for life in the north" (2011) identified the 9 most salient environmental changes facing the Norwegian Arctic as:

Figure 4 - NPI report's 9 key environmental changes threatening the Norwegian Arctic.

1: The Norwegian Arctic is getting warmer and wetter.

- A temperature increase of 0.4 °C per decade since 1960.
- Precipitation increase of 2% per decade during the last 100 years

2: Feedback processes in the Arctic increase global climate change.

- Albedo effect: reduced season with snow, less expansive sea-ice cover, soot accumulation and more forested area will result in the absorption of more sunlight energy and increased temperature.
- Large volumes of methane and carbon dioxide are stored in a frozen state in shallow ocean sediment and permafrost. As ocean and atmospheric temperatures rise, these GHG are being released and will result in even greater temperature increase.

3: Climate change makes the Arctic more vulnerable to environmental pollutants and ultraviolet radiation.

- Arctic sea ice stores great quantities of pollution which has been transported by sea and air from lower lattitudes. When the ice melts during the warmer months this can lead to dramatic toxicity levels in the sea.
- A reduction of ice cover exposes organisms to increased UV radiation.

Continued on P.9

[12] Tunstad 2007, met.no 2015 and NOU 1994, provide the basis for this historical background.

(NPI findings continued)

4: Sea ice is diminishing, threatening ice-dependent species.

- Areas which have been covered in ice year-round are now exposed, and thich multi-year ice is being replaced by thin annual ice.
- Without ice, the various types of ice algae will disappear. This algae provides the nutrient basis for grazing animals in the sea, who in turn support the fish stock. In addition, polar bears, seals and whales depend on sea ice.

5: The ocean is getting warmer and the ecosystems are changing.

- The Norwegian Sea has been increasingly warm and saline. In 2007 the temperature was 0.8 °C warmer than average and was the highest temperature recorded since measurements began in 1977.
- With warming temperatures, the distribution of species is changing as species from southern latitudes move further north.

6: The acidity of the ocean is increasing and coral species may disappear.

- The Barents and Norwegian Sea are becoming more acidic, which will make it more difficult for marine calciferous organisms (e.g. coral, shell-fish) to form shells.

7: Forests are spreading northwards and to higher elevations.

- Milder temperatures have allowed many species of trees to move into areas that have traditionally been colder, both higher latitudes and elevations.

8: Freshwater ecosystems are vulnerable to climate change.

- Increased temperatures and precipitation, as well as melting from surrounding permafrost affect the supply of nutrients and biological cycles.
- Many Arctic lakes are shallow bodies of water sitting above permafrost. They may be absorbed and disappear altogether as the permafrost below melts.

9: The infrastructure in the north is vulnerable.

- Sea level rise will present a challenge for the shoreline infrastructure.
- Increased floods, avalanches and landslides resulting from different precipitation patterns will affect transport and imply new risks for certain areas.

(NPI 2011)

The NPI report will serve as the scientific basis for climate change in the case study area, and was used extensively during the interview process. Yet as many respondents were aware, numerous observations referred to in the report are taken much further north in Svalbard and Jan Mayen. To what extent do the above findings apply to Finnmark, and to what degree can findings here be generalized to other Arctic communities?

Is Finnmark really "Arctic"?

Walking the streets of Hammerfest, with its cosmopolitan city life and fairly agreeable climate, the city certainly does not feel like other 'typical' Arctic locations such as Greenland, Siberia or the Canadian Arctic Archipelago; however, though it does lie close to the periphery of the region, Hammerfest certainly falls under all three commonly used definitions of "Arctic" (See Figure 1 - Arctic Map (Arctic Council, 2001):

- At 70° 39'N it is well north of the Arctic Circle (66° 32'N)
- Roughly 150 km north of the Arctic Tree-line.
- 70 km north of the 10º Celsius July Isotherm.

In addition to being indisputably Arctic in the geographic sense, Hammerfest's climate is undergoing the same dramatic changes as seen elsewhere in the region.

Temperature and Precipitation: It is getting warmer and wetter in Hammerfest. Based on historical weather observations (yr.no 2015), the yearly average temperature in Hammerfest has increased by 1º C from the 1900-1993 average to the 1994-2014 average[13]. Similarly precipitation has increased by 15% during the same period.[14] (see Appendix 4 - Hammerfest Temperature 1900-2014 and Appendix 5 - Hammerfest Precipitation 1900-2014)

[13] From 8.6º C average to 9.6º C (yr.no 2015)

[14] Hanssen-Bauer *et al*. (2009) estimate 2% per decade the last 100 years for northern Norway, so the yr.no figure is roughly in agreement.

Ocean Temperature: Ocean temperature readings from the Barents Sea show that it fluctuates between long cold and warm periods, but that the last 30 years has seen a rapid increase in temperature much higher than the long term mean, and recent years have seen the highest temperatures ever recorded in the region. (Hanssen-Bauer et al. 2009, as cited in Hovelsrud & Smit 2010: 34). (See Appendix 7 - Barents Sea Temperature 1900-2010)

Ocean Acidification: The Barents Sea has seen a decrease in seawater pH of 0.02 per decade since 1960's. Moreover, the large volumes of freshwater entering the sea from rivers and ice make it less effective at chemically neutralizing carbon dioxide's acidifying effect (AMAP 2013).

Forest Spread: the *forest-line*[15] has been observed to have moved 17.4 kilometers north in Finnmark at a rate of 183m per year, and will likely envelop the whole of mainland Norway by the end of the century should this rate continue (Aune et al. 2011). In addition the *tree-line*[16] has been observed to have risen 50m in elevation over the last 70 years, rapidly decreasing alpine area (Norklima 2015). It is believed the temperature will rise an additional 1.6°C in this century, which can see the tree line rise by 300m. 47% of Finnmark is below 300m, so it may be densely forested by the end of this century, while today there is none (NPI 2011). Due to the albedo effect,[17] forests heat up the atmosphere more than tundra or meadow systems and their increase will cause another positive feedback to the region's warming trend (Grace et al. 2002).

On the other hand, Hammerfest *is* somewhat atypical Arctic with regards to certain aspects of its social composition. Two differences stand out in particular: Firstly, it hardly acts as a distant outpost at the periphery of a greater center, but instead serves as an integrated part of the socio-economic field of Norway and greater Europe (Hovelsrud & Smit 2010). Secondly, northern Norway is arguably the richest Arctic region, owing to its oil and gas reserves and one of the most productive fisheries in the world (*ibid*).

[15] Forest-line: Where the space between trees of at least 3m tall exceeds 30 meters.

[16] Tree-line: The highest elevation where trees grow over 2m tall

[17] See Figure 4, #2 for explanation.

Indeed, as one of the wealthiest nations on Earth, it is difficult to find anything generalizable about Norway.[18]

These differences aside, northern Norway shows many similarities with other Arctic communities: its population is facing similar demographic trends, such as increasing urbanization, population decline in smaller communities, a wave of recent migration which has left the indigenous population a minority, heavy reliance upon natural resources, and relative isolation from major industrialized centers. In short, with the few disclaimers mentioned above, adaptation research conducted in Hammerfest can indeed both draw from and inform other Arctic research.

[18] Norway is ranked as the 6th wealthiest country in the world, based on GDP per capita (PPP), World Bank (2014).

2 Theoretical Approach

Adger et al. (2013) argue that many contemporary adaptation studies are constructed around three dimensions: ecological and physical parameters (e.g. fishing quotas), economic parameters (e.g. cost-benefit analysis), and technological parameters (e.g. harbor sea defenses). These types of 'top-down' studies lend themselves well to quantifiable data and to policy-makers looking for hard facts to base their policy on (ibid.). Meanwhile, subjective, social dimensions have tended to be sidelined, perhaps owing to ontological and epistemological incompatibilities with the dominant 'hard sciences' (ibid.). Yet it is increasingly acknowledged that subjective dimensions are crucial to both understanding the driving force behind climate change[19] and adaptation to it (Adger et al. 2013, and O'Brien & Wolf 2010, as cited in Amundsen 2014: 29).

One reason for this emerging focus on subjective dimensions is that climate adaptation policies which are based on the three aforementioned 'objective' empirical parameters alone often fail the moment they leave the drawing board (Adger et al. 2013: 113). Climate change is a complex phenomenon which occurs at multiple scales; therefore, no single scale is the "correct" one for analysis, nor will one level alone be sufficient in explaining the phenomenon in question (Holling 2004, as cited in Berkes 2007: 290). Thus, when adaptation research and the policies take the social milieu into which they are received and interpreted for granted, they fail to incorporate the various social forces which ultimately decide the manner in which this information will be used, or indeed, whether it will be used at all. Satellite *sensors*, for example, do not account for the human *senses* or the lived experiences, values, or goals of individuals on the ground. Hard facts do not always align with social actors; the ones meant to be *doing* the adapting.

[19] There is now broad consensus that the primary cause behind climate change itself is due to human activity, that it is *anthropogenic* (IPCC 2007). That is, its roots lie in those socially constructed practices which result in GHG emissions.

2.1 Social Constructivism

Though social constructivism has become a diverse field, the general argument uniting the various branches might be summarized as this: that which we know as reality is socially constructed, meaning that people collectively create and maintain social phenomena – including notions of *what is real* - through social practices (Berger & Luckmann 1966). Not only creators, individuals are also themselves formed by the social reality they are born into as they internalize its norms and knowledge (Alvesson et al. 2009: 14). Knowledge is therefore seen as contextually situated in human practices, meaning that there is no objective point of view (ibid: 16). Climate change, for example, is seen by many as an objective fact, demonstrable through empirical data which is representative of what is occurring in the 'real world.' Yet in the choice of phenomena to be measured, the logic with which to analyze it, and the rationale of how to act upon it, we find that all are subject to social processes which are unavoidably value-laden and subjective. Based upon this rationale, the primary data collected during interviews will be explored from a social constructivist theoretical perspective.

Insofar as theory is concerned, this research will not explore a more radical path which suggests that there is no knowable, objective, 'real world' at all, but only interpretations of it.[20] While mulling over this possibility is harmless, if climate change actually exists 'out there,' it may put humans onto a growing list of Earth's extinct species. It has already taken us 40 years to establish the *physical* basis of climate change and it would take at least as long to establish the *metaphysical* basis - perhaps now is not the best time to ponder the possibility that it is all just in our heads. In any case, while exploring the existence of objective reality is central to the social constructivism debate, it remains outside the scope of this study as it is precisely the ongoing social construction of reality itself, not objective reality, which is of key interest.

On the other side of the spectrum, some social constructivists (e.g. Bourdieu, Giddens) seek to build a more empirical and comprehensive theoretical framework to explicate the various social processes – creating a 'social reality' blueprint of sorts. Critics of this approach (e.g. Latour) argue that social research should focus on *how* constructions are

[20] e.g. Nietzsche

made and *how* individuals speak and act, and leave the 'why' to the individuals themselves who have the best ability to know and describe their own subjective perspective (Alvesson et al. 2009: 19). As a researcher, my bias in directing the interviews, dividing the sample, and analyzing the results, is to some degree unavoidable. Yet, in line with the above reasoning this project seeks to give voice to the respondents whenever possible and let them describe in their own words both *how* and *why* they perceive and act.

While this approach enables the collection of rich, descriptive and subjective data from the 'horse's mouth' so to speak, it serves less well in theory building and explaining macro-level phenomena. Therefore, I may be perceived to be on thin-ice when I expand findings from the individual level to a whole industry or community. Yet in light of the research question at hand which is concerned with the individual level in particular, I believe that the moderate take on social constructivism outlined above to be the most appropriate theoretical underpinning, and will tread lightly when commenting on possible macro-level implications of the findings.

Social Constructivism and Perception

Much of this research is concerned with collecting, organizing, and analyzing individual sensual perception in relation to the abstraction of climate change. It is important to note that taken from the perspective of social constructivism, sensual experience is too an abstraction, whereby our senses simply provide a mental representation of the perceived object/phenomenon. Moreover, as socialized beings we filter and interpret these representations according to our socially constructed meanings, thereby doubly mediating our experience with the object or phenomenon in question. In this case, learning about another's experience is at least thrice removed from reality, as one learns from the subjective experience of at least one other observer, or often the texts of one commenting on another's texts.

As such, the findings relating to respondent perceptions outlined in the pages that follow are not intended to represent objective reality. When viewed through the lens of social constructivism, the perceptions identified by respondents must be seen as just that, constructions. Interviewees are simply using their subjective experience to account

for the interview questions (of my subjective choosing) relating to environmental change.

Yet even so, as part of the respondent's subjective reality these perceptions and knowledges *do* have real impacts on their own lives, their communities, and the environment in which they are situated. To varying degrees these perceptions result in feelings of anxiety in the face of vulnerability to risk and in turn motivate agents to act.

2.2 Key Terms

Two key terms will be used extensively in the Key Findings and Discussion chapters ahead, and it is therefore imperative that they first be properly defined and operationalized. These terms are *vulnerability* and *adaptation*.

Vulnerability

The world is full of various *hazards*[21], and individuals and groups are differentially *exposed*[22] to these phenomena. Vulnerability, as generally understood, refers to the susceptibility to be harmed when exposed to a hazard. While climate change research uses it in basically the same way, it has evolved into a somewhat complex term, with a legion of sub-terms and sub-sub-terms depending on the level of analysis and discipline. For the purposes of this study I will endeavor upon a simpler approach by forgoing the specific nuances of vulnerability's usage. However, as the *vulnerability* of Arctic communities and the *vulnerability* of the primary sector were the sole reason these were chosen as a field study location and as respondents respectively, a few paragraphs on the matter are clearly warranted. The commonly used IPCC (2012) definition defines *vulnerability* as '[the] propensity or predisposition to be adversely affected' (p564).

[21] Hazard: 'The potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources.' (IPCC, 2012: 560)

[22] Exposure: 'The presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected.' (IPCC, 2012: 559)

This provides a wide-reaching definition, reflecting the systems-level of analysis that the IPCC is concerned with. Another definition by Blaikie et al. provides a greater emphasis on the exposure of people's or groups, defining vulnerability as:

> […] the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard. (Blaikie et al 1994, as cited in Angell & Stokke 2014: 57)

Vulnerability in these definitions is defined in terms of measurable traits, yet they neglect that vulnerability also has a subjective existence. Vulnerability may also refer to an experience, whereby an individual (or individuals) feel, suspect or fear some form of insecurity (Adger 2006: 271).

While definitions of vulnerability are many depending on the particular subject of analysis, the common elements which will be used in this research include an entity's i) *exposure* to a stress, referring to the degree to which the stress is experienced, ii) *sensitivity* to this stress, referring to the degree to which the entity is modified by the stress and iii) *adaptive capacity*, referring to the ability of the entity to respond and reorganize following a stress in order to increase its ability to meet a similar stress in the future (ibid: 270). This last term, *adaptive capacity*, provides a link from vulnerability to the next term, *adaptation*.

Adaptation

The second key term which will be used extensively in this research is *adaptation*. Adger et. al. (2004) define adaptation to climate change as:

> [a]n adjustment in ecological, social or economic systems in response to observed or expected changes in climatic stimuli and their effects and impacts in order to alleviate adverse impacts of change or take advantage of new opportunities. (p78).

In other words adaptation refers to an action taken in response to real or anticipated changes, with the goal of minimizing damage or maximizing gain. Adger et al. then observe that adaptation can take two primary forms: i) *anticipatory adaptation*, which seeks to increase the adaptive capacity in order to effectively adapt to anticipated exposures and ii) *reactive adaptation*, which transforms adaptive capacity into action

based on current exposures (ibid.). Adaptation is not to be confused with *coping*, which the IPCC (2012) defines as:

> [t]he use of available skills, resources, and opportunities to address, manage, and overcome adverse conditions, with the aim of achieving basic functioning in the short to medium term. (p558)

While coping is a short-term and immediate response to crisis, adaptation refers to a strategy which can be sustained and provide long-term security in light of the new conditions. Though this difference is meaningful, when applied to adaptation research the division becomes more obscure. For example, whereas an action in response to a change may at first glance appear successful and sustainable, when looked at from another scale or a longer time perspective the same action may in fact be less adaptive and more of a coping strategy that cannot be maintained (Adger et al. 2004: 78). Finally, some responses to climate change can be seen as *maladaptations* which the IPCC (2001) defines as:

> [a]ny changes in natural or human systems that inadvertently increase vulnerability to climatic stimuli; an adaptation that does not succeed in reducing vulnerability but increases it instead. (p378)

Many industries, for example, are able to provide tax revenues which in turn build a community´s adaptive capacity. Adapting infrastructure or economies to meet the challenges of climate change will come with considerable price tags, and these industries can help foot the bill. Yet if the industry is a high emitter of GHGs or other forms of pollution, for example, the assistance they provide in tax revenues may pale in comparison to the degree with which they contribute to climate change, exacerbating the problem both locally and globally and incurring greater costs in the future.

Social Constructivism when applied to Vulnerability and Adaptation

Many vulnerability and adaptation assessments have adopted a realist perspective, taking the world as an objective reality 'out there' (McLaughlin & Dietz 2008). In this case, when two rational individuals meet the same changes in objective reality, they would be expected to adapt similarly. This is, however, rarely the case.[23] Social

23 Adger et al. (2013) provide the example from Burkina Faso, where two groups of pastoralists are struggling with recurrent drought. The Fulbe are struggling to survive while their former slaves, the

constructivism has been seen to provide useful insights into the sometimes very different outcomes in social groups exposed to more or less the same environmental hazard. The socially constructed categories of race, ethnicity, age, gender, status and power (to name a few) tend to be sidelined in these analysis in preference of 'objective data,' though it is precisely these 'subjective constructs' which determine how people will perceive and act (ibid).

This study will be based upon an emerging research dimension (e.g. Adger, O'Brien) which focuses on social parameters, and views adaptation through the lens of social constructivism. From this perspective, adaptation is contingent upon the "goals, values, risk and social choice" which are all "mutable, subjective and socially constructed" (Adger et al 2009: 338). Adaptations will invariably reflect the attitudes and existing social norms of particular groups, and adaptation success must be defined as 'success for who?' (Adger et al. 2004: 79). For example, while maintaining system-functionality (or *status quo*) may be desirable for some, it may be detrimental for others, in which case the apparent strengths of certain segments of society may mask the weakness of other, more vulnerable groups (Obrien et al. 2006).

Implications for Case Study

Having identified the theoretical basis of this research and its key terms, how do these apply to the case study? Finnmark is exposed to numerous hazards, as identified in section 1.3, but to what degree is it vulnerable to these changes? While it will certainly face challenges, its ability to adapt to these challenges depends on a range of factors. As mentioned earlier, Norway has the financial and human resources to tackle climate change with far greater efficacy than most other nations. Moreover, Angell & Stokke (2014) contend that Hammerfest is particularly well-equipped to implement climate change adaptations on account of its ballooning budget due to LNG revenues. Anticipatory adaptations are currently well underway, with infrastructure and zoning in particular taking climate change into account (ibid).

Rimaiibe people, have successfully diversified their livelihoods through the use of labour migration. (p113)

Yet other research is not quite so optimistic, acknowledging that in spite of its recent boom, Hammerfest's economy is still highly dependent on the primary sector which is particularly vulnerable to environmental change. Groven et al. (2006), for example, peg the district of Hammerfest as one of the most vulnerable to climate change based on its proportion of employees working in climate vulnerable industries/sectors (see Appendix 3 - Proportion of employees in climate-vulnerable sectors in Northern Norway. 'Climate vulnerabilities are measured here based on a number of indicators, for example exposure to avalanches and floods, and an evaluation of the industry's climate vulnerability, infrastructure and the competence, economy and population composition of the municipality.' District of Hammerfest is within the 18.8 – 26.1% range. (Source: Groven et al. 2006). Finally, while exposure to climate change related hazards is one form of vulnerability the primary sector faces, it is also particularly vulnerable to swings in the global economy. In short, while Hammerfest may presently have the finances and human capital to cope with various environmental changes, should the primary sector falter Hammerfest may not have the capacity to finance and sustain adaptive efforts. The next chapter will continue by outlining the methodological approach to this study.

3 Methods

This study employed a multiple method approach which included the following methods: i) key informant interviews (n=15) and questionnaires (n=3) were used to provide the primary data for this study and ii) secondary data was used to support and inform my analysis and discussion. The secondary sources included demographic and climatic data as well as a literature review of just over 50 documents covering themes of climate change, vulnerability, adaptation, resilience, Arctic, and northern Norway. Using a sector-based, ground-up 'community-based approach' (CBA), three themes were identified through qualitative interviews which subsequently guided the direction of the research. These three themes were perception, identity and territory.

Though qualitative research is able to provide depth in understanding a contingent perspective, it is commonly viewed as weak in terms of its generalizability; however, the social limitations and enablers to adaptation identified in this sample represent qualitative phenomena that do not lend themselves to quantitative methodologies. Unlike 'observations' or 'facts' (e.g. temperature in degrees Celsius or acidity in pH value) which are regularly employed in quantitative climate change research, *perception* is contingent upon an individual's senses and subjective experience. Similarly employment statistics can provide insights into the changing livelihood patterns of communities, but do not capture the degree to which workers *identify with* their jobs. Finally, while property titles and GIS data can provide useful information about the spatial dimension, alone they belie the underlying social mediation and defining processes which determine *territory*, or who can utilize the same space. Social elements such as perceptions, identities, and territories all represent dynamic phenomena that cannot be adequately contained or explained by the positivist paradigm, and yet these elements are crucial to the conceptualization of vulnerability and adaptation which, after all, are socially constructed phenomena.

3.1 Primary Data Sources

Hammerfest has been used as a case study location in numerous recent studies (e.g. Hovelsrud & Smit 2010, Kelman & Naess 2013, Angel et al. 2014, Oort et al. 2012); however, in order to procure information not available in previous research such as

actor perspectives, opinions and motivations, this project included key informant semi-structured interviews as well as informal interviews which were then followed by thematic mapping.

A total of 14 semi-structured interviews were conducted using an interview guide (6 in person, 5 by telephone, and 3 by e-mail questionnaire). In addition, 4 interviews were of a more unstructured nature where the respondents themselves identified themes of importance to them. Out of a total of 18 respondents, 10 were male and 8 female and the ages ranged from 18-60. 15 respondents were Norwegian, while 3 were EU citizens.

Sampling Method

Four industries were identified prior to fieldwork as especially relevant to this sector-based approach: fisheries[24], reindeer herding[25] (hereafter *herding*), tourism[26] and liquefied natural gas (LNG). The rationale for this selection was two-fold: First, the primary sector's contribution to the local economy in terms of value-creation and employment[27] is substantial. As a highly productive sector employing a large portion of the community, the successes or failures of its industries to adapt to change will have significant ramifications for Hammerfest as a whole.[28] The second rationale is that

24 This segment included both fishers as well as fish-purchasing station operators.

25 This segment included several active reindeer herders and one Saami respondent with some relation to the activity.

26 The tourism industry traditionally falls under the tertiary, or 'service' sector. The rationale behind their inclusion in this sample was that outdoor adventure tourism's contact and exposure with the natural environment is similar to that of the primary sector, though they differ in their relationship to it. Also, this segment included several tour operators and tour leaders, as well as several active trekkers. As such, collecting them all under the 'tourism' industry is somewhat misleading, but I believe that due to the similar manner in which they use and depend upon the natural environment, this ought not compromise the data obtained from this choice of grouping.

27 Employing 25% of the workforce outside of the public sector. See Appendix 1.

28 One exception to this rationale is that of herding, which is neither a lucrative endeavor economically (Tyler et al. 2007), nor a large employer; however, due to its protected status and the significant implications this status entails for other industries, it was deemed relevant to this study.

these industries differentiate themselves from the public and service sectors due to their direct dependence upon ecosystem services/natural resources, and as such were suspected of being both more exposed to environmental change and as a result more perceptive of these changes. Just as I chose to use a particularly exposed hotspot as a case study location, the particularly exposed primary sector was chosen with the hopes of providing even greater magnification of the phenomena this study sought to examine.

The prospect of re-opening the copper mine in the neighboring District of Kvalsund was repeatedly identified by respondents, and was later included in the analysis. Other industries such as service, construction, utilities, transport, banking, civil servants etc. were, though certainly interesting and relevant in other respects, excluded from this project not only due to time limitations but also due to their relative degree of disconnect with the natural environment. This choice may reflect an assumption I carried with me into the fieldwork. Even so, my findings do provide some support for this assumption as I will argue in chapter 5.1.2.

CBA seeks stakeholder involvement, and takes a ground-up approach to identifying the variables which the stakeholders themselves deem important. CBA is able to provide contextual knowledge on a local level, in contrast to the aforementioned top-down adaptation studies which favor demographics and other quantifiable data (Hovelsrud & Smit 2010). Other variables than sector such as age, time spent in region, education level, socioeconomic status etc. would undoubtedly provide interesting insights into the research question. Questionnaires could have replaced interviews, and statistical analysis could have been used instead of thematic mapping; however, the research question sought individual perceptions and as such narratives, not demographics, were the preferred data.

The interviewees were contacted first and foremost in the initial stages of the desk study, and were found via internet searches of each of the five key industries. An alternative technique considered was to make initial contact with industry representatives followed by a snowball method, and indeed this was explicitly used once. My preferred method of contact, however, reduced the bias that follows the snowball approach, whereby the first contact made has a strong influence in determining subsequent contacts. On the other hand, lacking a complete registry over individuals sorted by employment, my selection method has the bias of selecting

respondents with a strong internet profile. For example, the average reindeer herder may not have a significant electronic footprint. When searching for names of herders, leaders or other members who have been active on social or traditional media – those with the loudest voices - are the easiest to find. This bias was partially reduced by a day of observation spent working with the herders, where I was able to perform interviews with several other members of the herding district.

Fishers were similarly difficult to identify and contact electronically. To solve this challenge, I contacted fish purchasing station owners and following interviews with them on site, waited on the docks to interview fishers as they came to unload their catch. This resulted in a bias which favored small-vessel fishers (under 15m vessels), as the larger fishing vessels call on ports with larger facilities. This is admittedly an important omission given the fishing strategies and vulnerability to natural and economic risks are presumably quite different between large and small vessels. Similarly fish farmers represent a sizeable portion of the industry and a potentially revolutionary adaptive strategy, yet regrettably were not included in this sample.

LNG workers provided an altogether different challenge. The main employer, Statoil,[29] was not forthcoming in connecting me with their employees, and no publicly available list was found. Initially I circumvented this barrier by performing a social media search of Statoil employees working in Hammerfest, and turned up over 50 names on Facebook. I contacted these by private message, and received positive responses from 3 engineers. During my fieldwork I acquired the name to a senior representative from one of the tourism industry respondents. Having a name, the Statoil telephone switchboard connected me, and I was able to procure one more interview.

The above sampling method was selective with the intention of collecting the experiences of those working in the sector of interest. The sample is therefore not representative of the inhabitants of Hammerfest as a whole. Yet there is little indication that the respondents otherwise are unrepresentative of their sector. By and large, once a

[29] A multinational oil and gas companies and the largest operator on the Norwegian continental shelf. The corporation is majority owned by the Norwegian state and headquartered in Stavanger.

respondent was identified and contacted, they were willing and enthusiastic in participating in this project.

Wording of the interview questions required special consideration as the intended interviewees would represent what I suspected to be quite opposing views – biased and leading questions risked compromising the validity of these interviews. For example, framing the questions with a climate change bias could lead respondents to answer in completely different ways than they would have had the questions remained neutral. On the other hand, beating around the bush would waste valuable time and potentially result in a copious amount of information irrelevant to the research question.

Much research has found that climate change is the least of people's day to day concerns, even those most vulnerable to it, and is instead far overshadowed by economic and political issues (Kelman 2014). Given the lack of time and financial resources, I chose to narrow the questions onto the one topic the project was concerned with – environmental change. Though this biased the direction of the interview, the interview guide was carefully designed such that it controlled each response by asking for specific observations by date and location, as well as specific actions taken by individuals in response to changes. There is no reason to assume respondents were inaccurate about events or memories. Finally, it is worth noting that such a small '*n*' implies a risk that the sample could be just one interview short of a perspective that contradicts the findings identified in this study. In the case of the mining industry, where $n=1$, this is particularly relevant. Yet as I will point out later responses within each of the other industries were remarkably unanimous, providing a degree of confidence to the assertion that they are representative of the industry as a whole.

Thematic mapping

Once the interviews had been transcribed, a process of elimination was conducted whereby topics of the interview guide which had not produced any noteworthy results were removed. Migration patterns of respondents, though interesting, was not found to be especially relevant to adaptation to changing environment - or at least not within this sample. Similarly, while government policy implications on adaptation are certainly an

interesting theme requiring exploration, the respondents were unable to provide any useful insights on this subject.

The interview sections which remained following this process were then subject to a process of thematic mapping. The theme of *perception* was somewhat of a given, as the interview guide was specifically designed to explore this theme. The themes of identity and territory, on the other hand, first arose during field work and were somewhat unexpectedly arrived upon.

The theme of *identity* solidified following an interview with a herder, where I was invited into his tent (*kota*) for a drink after a long day catching reindeer by the antlers. There in the dim fire light sat one of the most splendid families I have ever met, and the matron's softly spoken yet blazing words branded the subject into my mind, "a lifestyle you can change. We can't just change, this is our life!"

Similarly *territory* was a theme which grew during the course of the field study whilst trekking together with a guided group, interviewing participants and guides alike along the way. As we plodded through kilometers of undulating virgin tundra with the steel-blue expanse of the Barents Sea beyond, a white veil grew in the north and fell upon us with surprising speed. Taking shelter from the season's first snowy squall in a primitive stone hut, the conversation turned towards the Saami. Though respectful in tone, the negative implications of reindeer husbandry and herding on trekker's freedom in the hills became the central theme. I quickly took out my pen and paper after one respondent remarked, "can't they just go somewhere else? They already have the whole island!"

It may be apparent that I took a greater degree of creative liberty in writing the above accounts, reflecting the fact that I was quite honestly taken aback by the statements. Indeed, to a certain degree the themes of identity and territory were identified on account of the respondent's enthusiasm. Had I been sitting at my desk conducting thematic mapping with the text alone, it is not a given that these same themes would have been identified. Even so, it is precisely qualitative research's ability to include such elements as passion and indifference which is its strength, providing a far more 'human' portrayal than the quantitative data of the 'hard sciences' ever could. Thus, while on occasion my writing may be seen as indulging in qualitative research's

descriptive license, I can see no reason why the very strength of qualitative research should be restrained when it can be used to enrich our understanding of the world as the respondents themselves see it.

Case Study Considerations

Field work in the Norwegian Arctic was selected due to its clear relevance to the research question (as outlined in section 1.2), as well as due to financial and logistical advantages. Advantages aside, the field study location presented numerous obstacles such as the language barrier, access, and time. The north is a treasure of dialects, and many of the idioms used are lost on a non-native speaker. On the whole this was not experienced as a significant problem as the interview format allowed for me to request clarification when a response was not entirely clear. High quality digital recordings of both in-person and telephone interviews also allowed for me to listen and re-listen to certain sections while transcribing, until what was said became clear. On a few occasions, a native Norwegian speaker was asked to clarify.

Access to the field study location was limited by time and finances. Only five days of fieldwork were undertaken which had implications in interviewee selection, whereby most of my meetings needed to be arranged beforehand and on a very tight schedule. I focused my efforts on getting interviews lined up in the fisheries and herding industries, as I (correctly) assumed tourism, LNG and mining representatives would be much easier to access and interview by phone at a later time.

Ethical Issues

Several ethical issues arise with regard to the interviews. Firstly, individuals may find it discomforting to consider the potentially calamitous future they face. Questions were written in a manner that was sensitive to this fact, and most importantly interviewees were informed prior to their consent to partake in the interview of what type of questions to expect, and that they could withdraw their participation at any moment without explanation. Secondly, while full-anonymity was offered to interviewees, the nature of the case study location could potentially compromise this security. Hammerfest is a small community to begin with, and when identifying particular industries the ability to hone in on the identity of individual respondents is

even greater still. Yet only three respondents requested their identity remain anonymous, and I contend that those who are most easily identifiable did not request anonymity. In any case, respondent identities were not deemed relevant information and were therefore omitted from the report altogether, as were other identifiers such as gender, age etc. Their livelihoods were the primary attribute of interest.

3.2 Secondary Data Sources

In order to increase validity of my findings via triangulation, an extensive review of secondary sources was conducted. Relevant demographic and climatic data was reviewed, particularly from IPCC reports, the Norwegian Polar Institute, the Norwegian Meteorological Institute and Statistics Norway (SSB).

A literature review of just over 50 documents was conducted. These documents were identified and acquired via online journal database searches, using search criteria which focused on the themes of environmental change in the Arctic, northern Norway, and Hammerfest in particular. The reports were additionally sorted according to date of publication, whereby more recent research was preferred over older on the assumption that the scientific basis of the latter may no longer be valid in light of the fast rate of climate change. Fifteen reports were found to be particularly relevant to either the case study location or the theme of social elements of adaptation and were reviewed in greater depth. Quantitative climate change reports and qualitative adaptation research provided both reference points and anchors for my own findings, as well as the terminology and theoretical basis to explicate them.

4 Key Findings

The Key Findings of this report were derived from the key informant interviews performed during fieldwork, by phone and email questionnaire. Following thematic mapping of the transcripts, three themes were identified as significant to respondents from all industries. Subsequent reconfiguration of the data revealed what appeared to be substantial differences between industries with relation to these themes. This chapter will seek to outline the key findings concerning the themes of perception, identity and territory.

4.1 Perception

As stated earlier, climate change research has found the Arctic to be among the most impacted regions on Earth (e.g. IPCC 2014, ACIA 2004). From a historical perspective these changes represent a dramatic shift in what has been the normal climate Arctic communities have experienced over the last six thousand years. Despite their novelty, speed, and magnitude from a geological perspective, many of the changes are minute and occur over decades, making it far from given that Arctic inhabitants are aware of them at all. The bulk of the interview guide sought to shed light on exactly this uncertainty, exploring the stated perceptions of respondents and tying them to concrete events in their local environment.

In the initial stages of the interview, an open question was asked of all respondents regarding any and all environmental changes they had personally perceived. This allowed them to reflect upon and share their own experience prior to the biasing effect of the questions which followed. In general, this question elicited a response referring to the timing and temperature of the last few winters and little more. I had expected the respondents' ability to spontaneously recall perceptions of this nature to be minimal, and had prepared by including more in-depth follow-up questions. In order to determine whether or not the other allegedly dramatic environmental changes were in any way registering, I opted to ask specifically whether or not the respondent had perceived the changes established through scientific observation. These questions were structured around the findings of the NPI (2011) report (See Figure 4 - NPI report's 9 key environmental changes threatening the Norwegian Arctic.). From this report, 7 out

of 11 key findings were included in the interview guide, with the remaining 4 being deemed irrelevant to this particular research purpose.[30]

This section of the interview would proceed as follows: I would first read out the key finding, and ask if the respondent had any experiences relating to it. In some cases I would elaborate further by listing direct and indirect effects of these changes. For example, *environmental toxins* are especially abstract and imperceptible, and as such often failed to illicit a response. When I listed its secondary effects on local food and health, however, respondents were able to provide anecdotes where this change was perceived, though indirectly. Admittedly, this allowed a degree of researcher-bias to enter into their responses as I directed the interviewee's attention to particular phenomena; however, the same tactic was used in all industries and positive responses were followed up with specific anecdotal evidence in order to increase the validity of the response.

4.1.1 What was Perceived?

The responses from the 14 interviewees regarding individual perceptions of the 7 environmental changes drawn from the NPI report revealed that nearly half (45%)[31] of the changes were being perceived either directly or indirectly. In addition, a small percentage (6%) of responses referred to experiences that were related to the phenomenon in question, but did not represent specific experiences in time and space. What follows is a brief summary of the five key changes that had greatest consensus across industries.

"The infrastructure in the north is vulnerable" received near-consensus across industries. Sea level was the most commonly identified hazard, whereby storm surges were regularly observed swamping downtown roads and quays. Regular isolation of

30 These were: #2: Feedback processes in the Arctic increase global climate change (via albedo effect, tundra methane emissions, increased freshwater in ocean currents etc.). #8 Freshwater ecosystems are vulnerable to climate change. #10 Nature-based enterprises will gain new opportunities – and face new challenges. #11 Society can – and must – adapt.

31 7 questions asked of 13 respondents makes 91 questions total, with 41 answered in the affirmative.

Hammerfest due to the closure of transport corridors was also identified as a significant vulnerability:

Mining: "A problem is that once a road is taken out, the shortest detour can be 700km through Sweden and Finland – there are so few roads here."

Tourism: "Here you don't decide when to go to Alta, the weather does."

Sometimes storms can last for days, effectively isolating Hammerfest as airplanes and ships are forced to reroute and the only road connection to the mainland may be closed due to snow drifts and avalanches.

"Forests are spreading northwards and to higher elevations" also received near-consensus across industries, though its cause was disputed. For example, shepherding was once a dominant livelihood in the region, and grazing hindered the growth of trees and shrubs, encouraging grasslands in their stead. Today this livelihood has all but vanished in the District of Hammerfest, which some argue to be the root cause of the emergence of the many small stands of birch trees which have sprung up on the hillsides. Meanwhile some observations were from areas where this was unlikely the case. The herders, for example, noted that nearby *vidde* (alpine plateaus) to the south surrounding Kautekeino and Alta are filling up with birch, yet they have not been historically used as shepherding pastures. In addition, outbreaks of moth larvae which have become more common due to warming temperatures were observed:

Herder: "The *vidde* is filling up with trees, this I have seen. *Altaroaivi* was once *vidde*, now its forest... But as the forest increases with warmer temperatures, so do pests. There are huge areas of forest that are completely dead. It looks like there has been a forest fire…. You can see this in Repparfjord."

"The Arctic is more vulnerable to environmental pollutants and ultraviolet radiation" gained substantial commentary. The opening of the LNG plant and the soot emitted from flaring during the first few years of operation was commonly referred to:

Tourism: "The first year they flared so much, and the whole town was covered in black soot… We got free car washes at Statoil[32] during this period! But the worst was that it was a great blueberry year, yet we were recommended not to pick them."

In addition, commercial fishers have stopped fishing certain species such as the Greenland halibut (*blåkveite*) and avoided areas near harbors or shipwrecks due to high known toxicity levels. Similarly leisure fishers have ceased fishing from the harbor of Hammerfest due to high levels of lead, copper and mercury toxins. One commercial fisher recalled a period in the 80's when their catch increasingly included fish with tumors. S/he speculated this may have been due to Russians dumping atomic waste in the Arctic during that period. Several respondents mentioned the health and ecological implications of submarine tailings disposal (STD) of the proposed Nussir copper mine, and referred to alleged effects from previous mining in the area:

Herder: "There had been so much mining where I grew up… This all lead to widespread health issues like psoriasis and other autoimmune sicknesses. And now there are studies showing an increase in these sicknesses surrounding these types of industries. Money is more important than our health!"

"The Norwegian Arctic is getting warmer and wetter" perceptions were common, though somewhat contradictory. Some perceived far less snow than normal, others the opposite. Respondents from the tourism industry, for example, had noticed less skiable days over the last years and the owner of a family fish-purchasing station owner remarked that the previous winter had been the first in living memory in which s/he did not need to shovel the loading docks once. Meanwhile, others remarked on how much more snow the previous year had had than what they perceived as normal. The Saami experienced the change in winter temperature as a significant problem, whereby thaw/freeze cycles cause an ice layer to form over the lichen, making winter grazing much more difficult for the reindeer:

[32] In addition to oil and gas exploration and extraction, Statoil also operates petrol stations.

Herder: "The winters in southern Finnmark are likely warmer; the winter grazing isn't so stable now… There have always been bad winters, but now I feel like it's more often."

Herder: "When we move the reindeer we do this according to temperature, and when snow melts. Some friends have problems as tundra melts and leads to water on the surface. There has been very little snow, so instead it becomes rain and ice on the ground which makes for terrible grazing."

"For me it is strange that it rains in December and January when the sun is gone, this feels against nature. I came here 20 years ago, and can say it has become much milder since."

"The ocean is getting warmer and the ecosystems are changing" gained numerous comments from all industries, largely relating to the appearance of new fish species on the end of their fishing hooks in recent years:

Fisheries: "Mackerel has come and that is new. Herring[33] has also showed up which is rare."

In addition, green algae have become a nuisance for commercial fishers. Green algae thrive in warmer water and deplete oxygen available in the water, effectively creating dead zones for larger marine life. Fishers must fish further afield in deeper, colder waters to avoid it:

Fisheries: "…the hand-line (*juksa*) fishers, who are traditionally out in June and July, are unable to catch anything the last few years due to all the green algae." (Fish purchasing station owner)

The above is only a small sample of what respondents had to say with regards to their own perceptions of environmental change. Indeed, many of the changes and vulnerabilities selected from the NPI report are being directly or indirectly perceived in a diverse range of contexts.

[33] According to fisheries.no (2015), herring's appearance in Hammerfest may not be so rare, as it lies in the centre of the Herring's nursery area up until age three.

What was not perceived?

It is also noteworthy that two key findings were not perceived by any respondents, namely that the Arctic sea ice is diminishing and the ocean itself is becoming more acidic.

With regards to ocean acidification, only conjecture was offered. One respondent reported that while he/she once enjoyed many diving trips in Kirkenes to harvest scallops, they were no longer to be found in those waters, possibly due to acidification. Another commercial fisher observed that arctic cod is very reliant on shellfish, and although the total weight of arctic cod caught has been record-breaking over the last few years, individually the cod are skinnier than normal, perhaps due to insufficient shellfish. Another fisher, however, contended that the last few years has seen record-breaking shrimp catches, representing to him/her a paradox of simultaneous and sustained record numbers of both predator (cod) and prey (shrimp). Although ocean acidification may represent a severe threat, it is had not yet resulted in any credible, perceptible changes according to the interviewees.

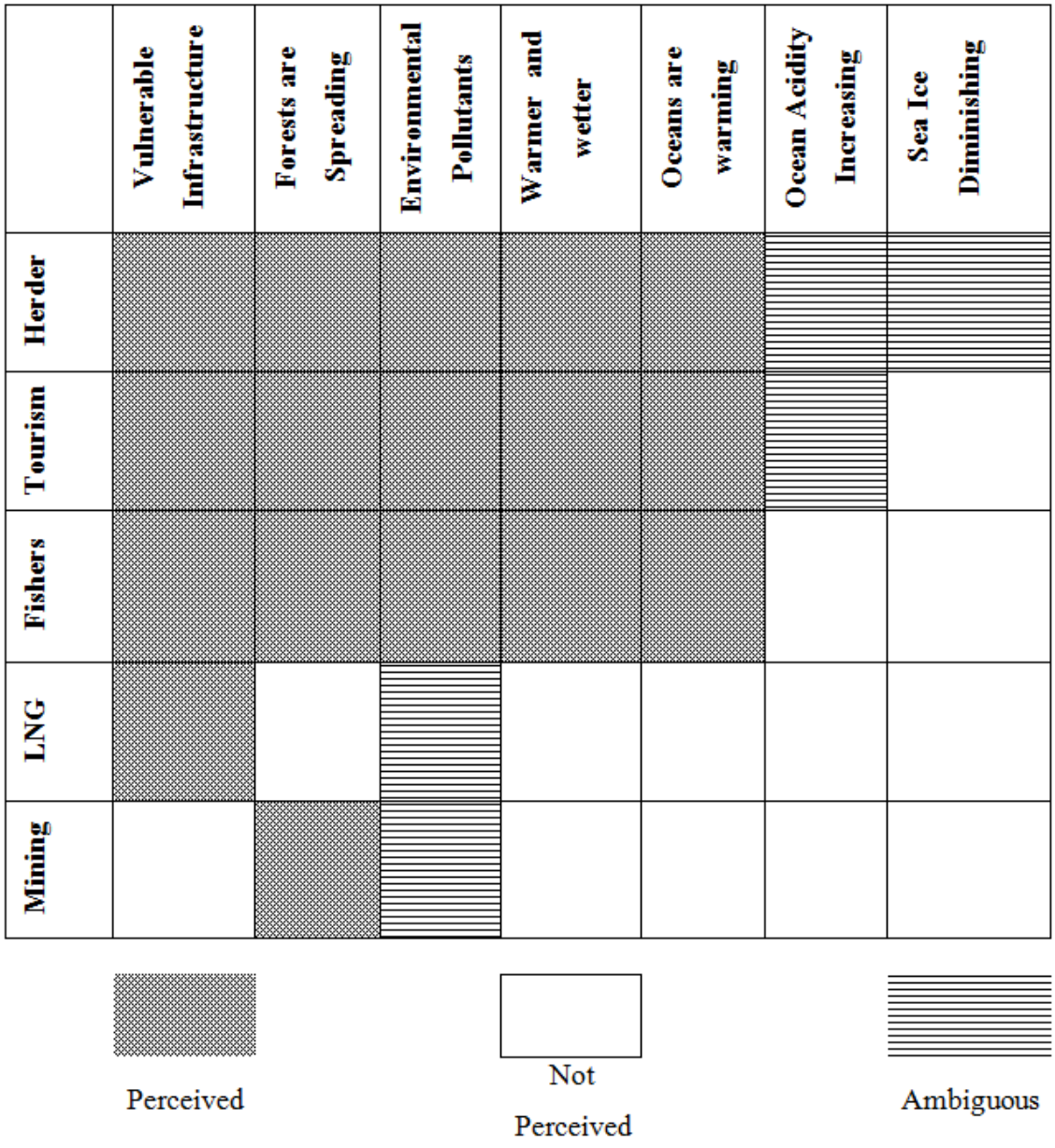
None within this sample had directly or indirectly perceived sea ice loss. The closest a respondent got to "seeing" this change was in a MMS from a friend who sent a picture in 2013 that was taken on a boat 84 degrees North – just 6 degrees south of the geographic North Pole, which showed a panorama of ice-free ocean. If this is accurate, the vessel was roughly 400 km north of the normal summer sea-ice extent. Yet the evidence remains purely anecdotal, and published reports place the lowest historic summer sea-ice extent in this region at approximately 81 degrees North in 2012 (NASA 2012).

Granted, Hammerfest is roughly 1000 kilometers from the Arctic sea-ice edge and the small vessel fishers I interviewed had never voyaged so far; however, one of the anticipated indirect effects of sea-ice loss is its negative effects on ice-dependent species such as arctic cod, which according to one respondent provides for as much as 80% of their income. Yet as mentioned above and contrary to expectations, the arctic cod catch has never been higher.

4.1.2 Differential Perception by Industry

The findings relating to perception from section 4.1.1 are presented in the table below, whereby responses are organized in descending order from left to right and top to bottom according to those key findings most perceived and by industry.

Table 1 - Respondent Perceptions of Environmental Change



A cursory look at the table finds a distinct cluster of perceptions in the upper left-hand portion of the chart, representing what was perceived and by whom. A clear schism is evident in the sample: individuals in the fisheries, herding and tourism industries are far

more perceptive of the environmental changes referred to in the NPI report than respondents from the LNG or mining industries.

When the NPI report's key findings #4 and #6 are removed (sea ice diminishing and ocean acidity increasing respectively - which had no reported experiences within any of the industries), respondents from fisheries, herding, and tourism had an affirmative response rate of 78%[34]. By contrast only 10%[35] of LNG and mining responses were answered in the affirmative.

4.1.3 Link between Perception, Vulnerability, and Adaptation

In addition to identifying the degree to which individuals in hotspots perceive climate, the research question concerns the proposed link between *perception* and *adaptation* found in other adaptation research, and the interview guide included questions which were meant to explore this connection. During the interview, once a specific change was identified as being perceived and was verified by a specific anecdote, the interviewee was then asked two more questions: "How does this affect your livelihood? (Or "is your industry vulnerable?") and "What are you doing in response?" (Or "how are you adapting?"). The replies to these questions support the hypothesis that there is a correlation between perception and adaptation, as well as vulnerability. Below is a compiled summary of this relationship grouped by industry, based on the respondents' own responses to a particular change:

Fisheries: Warm ocean temperatures were observed (Perception) in the form of green algae, which makes for poor fishing in that area (Vulnerability). Deep water fishing was used as a strategy when this condition occurs (Reactive adaptation).

Herders**:** Milder winters were considered to be on the increase (Perception), and led to poorer grazing conditions (Vulnerability). The herders respond by feeding with hay, changing herd composition, or choosing different grazing ranges (Reactive adaptation).

[34] 9 respondents x 5 questions = 45 questions. 35 affirmative answers / 45 questions = 0.78

[35] 4 respondents x 5 questions = 20 questions. 2 affirmative answers /20 questions = 0.1

Tourism: Milder winters were seen as resulting in a longer snow-free season (Perception), which reduces ski tourism and recreation (Vulnerability). A solution is to prolong the hiking season (Reactive adaptation).

LNG**:** Sea level rise and increased storms were known as factors (Perception), and regarded as threats to the plant's infrastructure (Vulnerability). A storm wall was built surrounding the production facility, and the loading docks were built at a height above the sea to compensate for projected sea level rise during the lifespan of its production (Anticipatory adaptation).

Mining**:** Did not perceive change, was not vulnerable to the projected changes, and had not engaged in adaptation (though the project was not yet underway). The respondent, however, mentioned a personal interest in hiking, and had noticed that hiking areas s/he was familiar with were filling up with forest (Perception). Favoring alpine views, this respondent now sought out higher elevations in order to come above the tree line (Reactive adaptation).

The above represents only a sample of interviewee responses, and many additional examples were found which support the link between perception, vulnerability and adaptation. The only exception was the fisheries industry's vulnerability to both sea ice loss and ocean acidification. Here, vulnerability was expressed, but neither a perception of the changes nor adaptation to them was evident. Table 2 - The Relationship between Perception, Vulnerability and Adaptation (on the proceeding page) expands upon Table 1, including the variables of adaptation and vulnerability in addition to perception.

Key Finding I 'Perception' Summary

To summarize this section's findings i) nearly half of the listed environmental changes were perceived by respondents, while several were ambiguous or not perceived at all ii) a significant difference exists between industries with regards to perception and iii) support was found that perception, vulnerability and adaptation appear correlated Having outlined the findings relating to the theme of perception of environmental

changes, the next section will identify the impacts these changes may imply for respondents' identities.

Table 2 - The Relationship between Perception, Vulnerability and Adaptation

		Vulnerable Infrastructure	Environmental Pollutants	Warmer and wetter	Forest Spreading	Ocean Warming	Sea Ice Diminishing	Ocean Acidity Increasing
Fisheries	Perceived	■	■	■	■	■		
	Vulnerable	■	■	■		■	■	■
	Adapting	■	■			■		
Herders	Perceived	■	■	■	■	■	≡	≡
	Vulnerable		■	■	≡			
	Adapting		■	■				
Tourism	Perceived	■	■	■	■	■		≡
	Vulnerable	■	■	■				
	Adapting	■	■	■				
LNG	Perceived	■	≡					
	Vulnerable	■						
	Adapting	■						
Mining	Perceived		≡		■			
	Vulnerable							
	Adapting							

■ Affirmative Response

Negative Response

≡ Ambiguous

If the hypothesis that a correlation exists between perception, vulnerability and adaptation is valid, we would expect to see that affirmative perceptions of change occur alongside vulnerability and adaptation to it. Contrariwise a positive response to 'adaptation' would not, for example, occur in absence of a positive response to vulnerability and perception. The most common arrangement for those changes that are currently being adapted to supports the hypothesis.

4.2 Identity

Following the section of the interview covering perceptions was a section which explored how the respondent would react if they were forced to seek new employment or relocate should the environmental changes listed in the NPI report worsen, or for whatever other reason. Most respondents viewed such an event as highly unlikely in the near future, so I would elaborate by presenting hypothetical scenarios such as: "oil and gas drilling is banned from the Arctic," "arctic cod stocks move out of Norway's Exclusive Economic Zone (EEZ)," or "reduced grazing pasture makes reindeer herding economically unviable." Once a scenario was established specific to the respondent's context, they seemed to find it easier to respond on a hypothetical level of how they might respond.

The intention of these questions was initially meant to gauge the respondent's level of preparedness for change and adaptability, but it soon became apparent that there lay another interesting subtext to their responses: for some, the prospect of changing livelihood or place of residence evoked an emotional response while for others it represented no threat, on account of what I suggest to be the degree of import these factors have on the respondent's sense of identity. I decided early on in the interview process to follow up on this theme, and found unanticipated consistency in responses within each industry. The simplest method of presenting this finding is to let the words of the interviewees speak for themselves. Below follows the translated responses to the question "What would you do if you had to move or change employment?" grouped by industry.

4.2.1 Strong Identification-with Livelihood

The respondents who expressed the strongest identification-with their livelihood were certainly the herders. For them, it seems that their livelihood is not simply an activity they find themselves in between 9am and 5pm in order to pay the bills – reindeer herding is a way of life, and one that has been a part of their cultural identity for millennia. The transcriptions below reflect this, though they are utterly inadequate in their ability to capture the passion of the responder:

Herder: "A lifestyle you can change. We can't just change, this is our life!"

Herder: "I will keep doing this no matter what, even long after I have gone on pension. It's not about the money."

One Saami respondent was no longer involved in reindeer herding, but her[36] commitment to her livelihood and the responsibility she believed it entailed is also worth noting in this section:

Saami: "What worries me most about [environmental toxins] is that this affects my closest family and friends. I am a midwife to my people the Saami. I am called '*Calbmeeadni*,' she who sees. This implies responsibility I think."

Though perhaps their degree of fervency was not as great, the fisheries interviewees also responded somewhat uniformly when asked what they would do if they were forced to either change employment or location:

Fisheries: "Fishers are not cut out for any other type of work. A 9-5 office job is impossible for us. We need to get out in the open, out to sea."

Fisheries: "No backup plan. My family has been doing this here so long. Get a job at [a grocery store]? I don't think so."

Within the sample of these two industries all respondents viewed such a future scenario as bleak, without exception. Most respondents from these industries came from families which had lived and worked in the region for several generations, and had apparently incorporated both place and livelihood as components of their cultural identity. The degree to which this forms their identities is not clear, but for most respondents the loss of place or livelihood would represent a significant personal loss. By contrast all respondents from the other industries perceived the potential demise of their livelihood or place as not representing any significant trauma, again without exception.

[36] Respondent's gender is in this case not censored, due to the nature of her livelihood as midwife.

4.2.2 Weak Identification-with Livelihood

The tourism respondents, who showed a similar degree of perceptiveness as fisheries and herders in the previous section "Perception," now differentiated themselves in regards to their livelihood identity. Most tourism respondents lived and worked in Hammerfest as it was seen to be adventurous, and could just as easily pack up and move should conditions require or should the adventure become less enjoyable:

Tourism: "Stay here another year then off to [another country][37] for work. If tourism industry fails I could take another job in management or sales."

Tourism: "We are here for the snow. If it stops snowing we will just move."

The LNG industry had similarly little concern over the hypothetical demise of their industry or having to move to another place:

LNG: "Came here for the adventure… Most Statoil employees see this as a first step to get a better job south."

LNG: "My education is so flexible it wouldn't represent any problem if I were to lose my job. I wouldn't mind moving, and could settle just about anywhere."

Finally the mining industry respondent was optimistic about his/her future should the mining industry fail:

Mining: "I have a lot of experience in different fields so I'll do just fine."

It appears that at least for some respondents, work is just work. Little emotional attachment is placed on their source of income, and concern over the potential need to change workplaces poses no threat to their way of life, which seems otherwise detached from their employment. It is a means to an end. Yet for other respondents, work is experienced as a means unto itself – as a way of life. It is a significant part of their identity. The loss of their livelihood would likely result in the experience of substantial personal loss. Again, it is important to note that with such a small *N*, the proposed

[37] Specific country censored in order to protect respondent's identity.

correlation cannot be seen as statistically significant. Yet it is worth remarking that there were no respondents who deviated from the apparent consensus within their industry. All herder and fisheries respondents expressed their concern over a potential need to change careers, while none of the other industries' respondents showed the slightest worry.

Key Finding II 'Identity' Summary

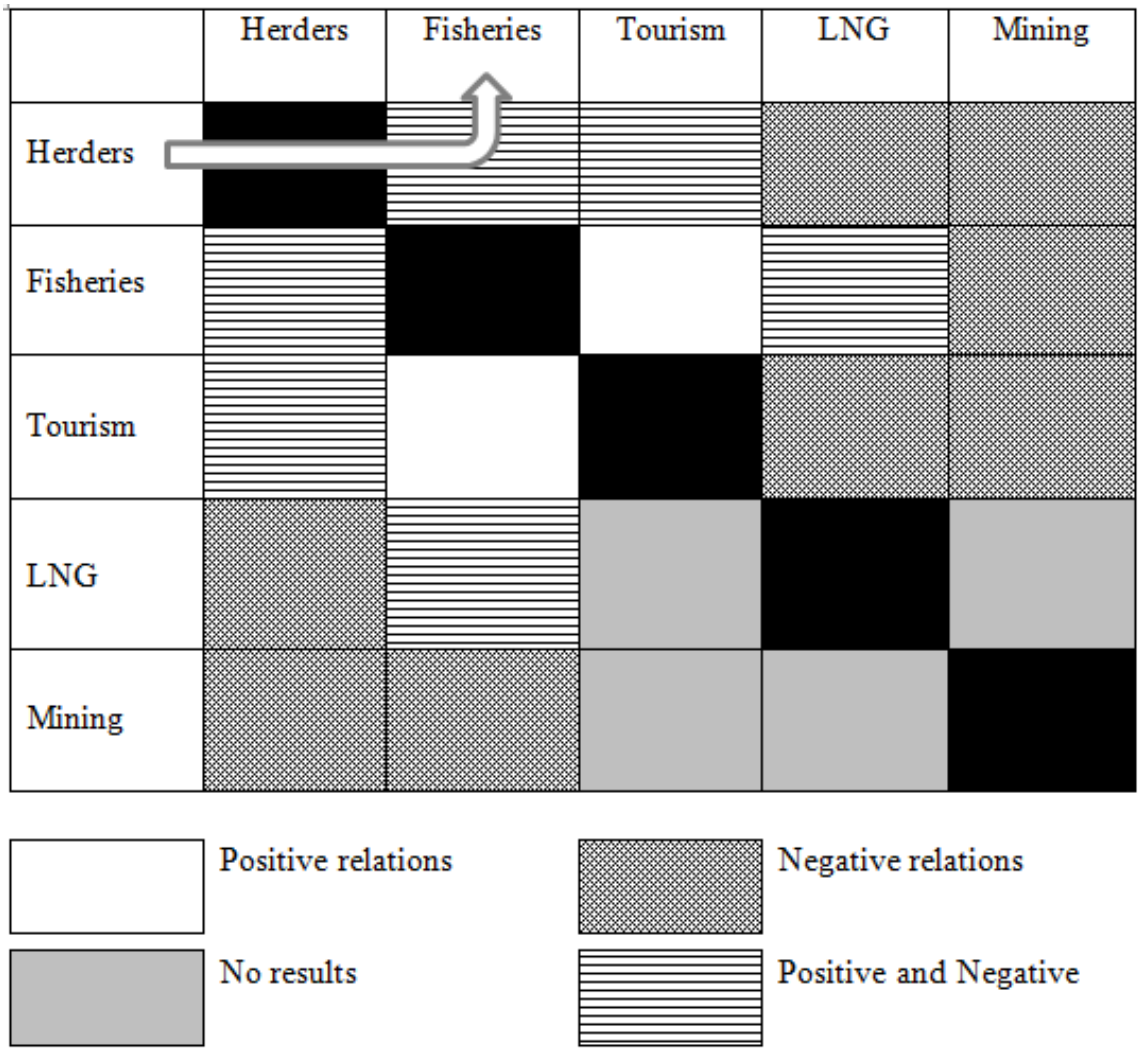
To summarize this section's findings i) fishers and herders expressed a stronger attachment to their livelihoods, and were not optimistic about a future that would require them to change employment or place of residence and ii) respondents from the tourism, LNG and mining industries expressed no such attachment to their livelihoods, and were optimistic about their future should they be forced to seek new employment or a new place of residence. The next section will identify the third and final theme.

4.3 Territory

One of the final sections of the interview guide sought to identify the constraints limiting each respondent's ability to adapt. The initial formulation of the questions focused on how both local, regional and national government regulation interfered with their efforts to adapt to changes they had observed as significant to their industry. Yet it quickly became apparent that respondents found it difficult to answer this question. This may have been caused by the wording of the question, or that the respondents simply did not have much to say on the matter. In its stead, I began asking what/whom was making their efforts to adapt more difficult. Here I found ripe grounds for controversy, with each industry holding somewhat vehement views about another industry's intrusion against their interests. Though it was never explicitly used by the interviewees, after reviewing the responses there is one term which may operationalize the underlying conflict: *territory*. This word has numerous usages, but the one which perhaps comes closest to my intended meaning is found in the combination of two definitions: i) "An area in which one has or claims certain rights, or for which one has responsibility with regard to a particular type of activity" (Oxford 2015) and from the animal kingdom ii) "the area that an animal defends against intruders, especially of the same species" (Dict. 2015). Thus, I use territory to describe a space where individuals

or groups have or claim rights and responsibilities, and one which they defend against intruders. Table 3 - Territory Relations between provides a visual representation of territory relations between each of the industries included in the study. Out of 20 relationships 8 were stated as negative, 6 as both positive and negative (mixed), and 2 as positive.[38] 4 relationships were not identified by respondents and their opinions regarding them are unknown. These data gaps form the 'no results' category.

Table 3 - Territory Relations between Industries



The table should be read from left to right in the manner identified by the inserted arrow. In this case, the herders identified their relationship with the fisheries as *mixed,* that is, both positive and negative.

[38] Note: a relationship goes two ways, and while one industry may have regarded the relationship to another positively, the same sentiments may not be felt by the other industry.

4.3.1 Territorial Conflicts

Respondents from all segments in the sample referred to numerous conflicting territorial interests between industries. A few of the most prominent conflicts will be outlined below:

Tourism, LNG, Mining and Fisheries vs. Herders: The greatest territory conflict identified by respondents related to the herders, who require huge tracts of land to remain largely pristine and free from intrusion to ensure their herds have enough grazing pasture and do not get frightened off. As the only recognized indigenous people in Scandinavia the ILO-Convention No. 169, which Norway has ratified, grants them special consideration in disputes which impact their cultural traditions and livelihoods[39]. Many respondents were able to appreciate the necessities of the reindeer herding livelihood, yet expressed frustration with what they perceived to be the herders' unwillingness to compromise:

Tourism: "The Saami have too much power- they say no to everything in their areas – which is basically everywhere!"

LNG: "Reindeer herders are against everything, like the electric power lines we want to connect to Melkøya"

Mining: "It's just for principle that the Saami are getting involved."

Fisheries: "Reindeer herders get in the way when we want to improve infrastructure. They mess things up for us."

The herders, on the other hand, identified multiple threats to their territory:

[39] ILO-Convention No.169 states that '…handicrafts, community and locally-based enterprises, natural economy and traditional enterprises for relevant groups, such as hunting, fishing, trapping and gathering shall be recognized as important factors in maintaining their culture, economic self-support and development. When this is relevant, governments shall ensure that such enterprises are supported and promoted, with the participation of the people.' (ILO Convention No. 169, as cited in NPI, 2011: 110)

Herder: "The [District of Hammerfest] infringes on our grazing grounds more and more, as do hikers and other groups. We try going further from civilization, but then these places just get overgrazed."

"…if Hammerfest expands too much, then we have no summer grazing grounds left and that would be the end of us. We can't have summer grazing somewhere else because the other herding districts have claims on the other surrounding areas. We are already pressed for area with the other districts and other user groups, so there is not much room for growth or adjusting to new circumstances."

"…[LNG] makes Hammerfest rich and the people want to build more huts in the wild. And they need infrastructure that has significant implications on our grazing territory. Hikers try to adapt to our wishes, but there is still lots of conflict. People are nice, but don't understand the implications of scaring our herd, especially while they are calving."

Herders, Fisheries, and Tourism vs. Mining: Receiving equal response was the potential conflict presented by the proposed Nussir copper mine in the neighboring District of Kvalsund. At the time of fieldwork, the proposal had just been approved by the local government, and awaited only approval by the Ministry of Environment (Miljødirektoratet) before it was able to begin operation. The proposal involved an underground mining operation on the site of an existing decommissioned mine, in addition to a submarine tailings deposit for its waste in Repparfjord. It is the latter of these which created the most controversy.

Fisheries: "We can't have it both ways: dumping in the fjords and selling our fish as the world's finest, most uncontaminated meat."

Tourism: "If Nussir is passed they will close off a lot of mountain area for hiking."

Herder: "[The proposed mining project] is right along our herd's autumn migration corridor."

The mining industry respondent was well aware of the criticisms directed to the proposal, but dismissed many of the concerns as unfounded and argued that the conflict could be averted by "…communication and willingness to work together."

A final conflict involved fishers worried about potential accidents from the LNG facility or transport ships contaminating their fishing waters. The development of the LNG plant *Snøhvit* ('Snow White') changed the face of Hammerfest virtually overnight, and initially met a great deal of skepticism from the established industries. Though many in the sample identified numerous conflicts, many of these dated back to the startup phase of production, and they now saw the plant as less of a threat. LNG respondents were now quite optimistic about their standing in Hammerfest:

LNG: "In the start Saami and fishers were worried about the chemicals, but the last years we have received no such criticism… People see the positive side-effects of oil industry in Hammerfest like jobs, the Cultural Center etc."

LNG: "Most people…are happy seeing what we have meant for the area…I think there is a place for us and everybody else."

In sum, the majority of territorial claims and requirements between the industries identified in this sample are a source of conflict, not cooperation. The negotiation of the various claims and their results I will later argue can have implications on their adaptation efforts. But first, what of relations within industries? What role does territory play between individuals who share the same livelihood?

Territorial Conflicts within Industries

Even within industries, boundaries are demarcated. Respondents from the fisheries and herder industries named the following as significant factors limiting their possibilities to move and adapt to changing economic and environmental conditions:

Fisheries: Fishers face numerous challenges within their territory, which represents perhaps a rather amorphous space relative the other industries. At the national scale, Norwegian registered boats can fish the whole of the Norwegian coast; this means that local fishers from Hammerfest have a significant degree of freedom to fish wherever

they perceive it to be economically feasible to do so. Yet the flipside of this freedom is that they face competition from fleets that travel up to 600 km from Nordland County as they follow the cod's seasonal migration.[40]

At the regional scale, fishers encounter what might as well be a brick wall as they follow the cod further east: Russian territorial waters. Although cooperation between Norway and Russia was claimed to be exemplary in insuring sustainable management of cross-border fisheries, only the fish are permitted to cross this boundary.[41]

Finally at the international scale, fishers can cross the 200 nautical mile limit of Norway's EEZ and fish in international waters - though these spaces are few within the vicinity of Norway - and once there fishers may have to compete with industrial fishing boats from across the globe.

Herders: At the national scale, reindeer herders are by law[42] required to be members of reindeer districts (*siida*). These districts cover distinct geographic areas, albeit ones that can overlap with neighboring districts. This overlap, however, does not imply simultaneous access/use. Instead, usage is seasonal in nature and strictly coordinated, whereby the spring grazing of one district may be the fall grazing area of another. Meanwhile on a regional scale, it is currently unfeasible for reindeer herders to cross the national borders of Sweden and Finland with their herds due to stringent regulations.

The responses of the participants painted a somewhat inharmonious picture, but are conflicts really the norm? Is there so little space that the various industries cannot help but lock horns at every turn? One LNG respondent did not think that this was inevitable, contending that, "there is enough space for us and everybody else here." The mining respondent was similarly optimistic observing that "it's a big fjord, with plenty of room." Repparfjord is indeed large and the Barents Sea much larger still. As the largest county (*fylke)* in Norway, one would imagine Finnmark has enough land to go

[40] See Figure 2 - Norwegian Exclusive Economic Zone and Fishery Zones. (FAO, 2015)

[41] Though it is crossed regularly without permission, as illegal fishing in this border region has become a significant problem.

[42] Lov om Reindrift (reindriftsloven).

around. The question arises whether or not cooperative, or at least non-conflictual, relationships can and do exist between and within industries?

4.3.2 Territorial Cooperation

While territorial conflicts make up for the majority of relations in this sample, a review of the transcripts revealed that respondents identified 6 mixed relationships, 2 positive relationships, and 4 relationships lacking data.

Mixed Relations - Among the mixed responses, the following industries have a somewhat ambiguous relationship to one another:

> **Fisheries and LNG**: While on the one hand LNG extraction from the Barents Sea seabed presents a risk to fish stocks if an accident were to occur, the fishing fleet has been employed as emergency respondents by the LNG industry, providing extra income to fishers in the off season as they train in preparation for a possible accident.
>
> **Herders and Tourism:** Reindeer grazing and calving makes large swaths of land out-of-bounds for tourism at certain points in the year, but then the Saami culture provides a unique tourist attraction to the region. Some reindeer herders were said to receive a sizeable share of their income by providing various cultural tourist attractions.
>
> **Herders and Fishers:** While the territory of fishers is primarily sea-based, its infrastructure requirements in ports had allegedly conflicted with the herders' interests on numerous occasions. Other fishers identified herders as allies in protesting the Nussir mine. The herders did not mention any conflict with fishers specifically, though referred to infrastructure in general as a problem.

No Results - The relationships identified as 'no results' are, as mentioned earlier, gaps in the data and as such cannot be scrutinized any further based on the research's primary data alone.

Positive Relations - The only positive relationship mentioned in the sample was found between tourism and fisheries. The tourism industry currently gains much from the fisheries industry. Firstly, the aesthetic charm of a living fishing industry itself was said to serve as a pull-factor for tourism. Secondly, products such as stockfish provide unique and sought after souvenirs. Thirdly, the fishing fleet provides private chartered fishing tours. This all in turn provides a significant source of supplemental income to fishers which often coincide with the off-season.

Key Finding III 'Territory' Summary

To summarize the findings of section 4.3, i) respondents identified numerous conflicts over and constrictions upon their territorial claims which occur at different scales: local, national and regional ii) actors within several of the industries also compete among themselves within the same territory iii) cooperative relationships were also identified, but were relatively rare. This concludes Chapter 4, 'Key Findings,' and the following chapter will endeavor to examine the implications of these findings.

5 Discussion

Having identified and interviewed a sample from the case study location, I then identified themes which related to environmental change and the respondents' perceptions, identity, and territory. Within each theme, some clear differences were noted between industries. Subsequently, a review of relevant secondary sources sought to find support for these findings and explored their implications on adaptation to environmental change in Hammerfest. The ensuing discussion endeavors to synthesize my own findings with that of other adaptation research in order to both explicate and infer the potential implications of these findings.

5.1 Perceiving Change

The primary aim of this section is to examine the connection between perceiving climate change and adapting to it. In Chapter 4.1 'Perception,' I outlined the findings relating to perception which identified that i) nearly half of the environmental changes drawn from the NPI report were perceived by respondents in the sample ii) perception was correlated with vulnerability and adaptation and iii) that a significant difference existed between industries. Before proceeding to explore these connections, a critical examination of the concept of perception itself is warranted.

As noted earlier, interviewees were asked to explore their perceptions of environmental change, not climate change *per se*. This distinction was necessary to frame the question in unloaded, lay-terms, which would resonate with the general public (Amundsen 2014). It was also necessary in order to include several of the NPI report's key findings not directly related to climate such as environmental pollutants and ocean acidification and those which are secondary effects of it such as forest spread. Yet the questions asked were indeed formulated according to the findings of the NPI report which clearly identified the bulk of its observations as the result of climate change. Can we then say that individuals whom perceived events in agreement with the observations outlined in the NPI report were *de facto* witnessing climate change? To answer this, a clearer operationalization of the term is necessary.

According to the IPCC (2012), *climate change* refers to:

> [a] change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. (p1760)

In other words, it is a statistical description, one that reflects the probability of a certain climatic parameter's value either increasing or decreasing based upon an abundance of historical data, scientific observations and climatic modelling (Weber 2010). This does not sound like the stuff of human sensing, which is occupied with the sensation of summer heat, the smell of the sea and the memory of a white winter years ago. Questions like "have the last 20 summers been warmer than the 20 before that?" are extraordinarily difficult to answer with any degree of validity, based on the senses and memory alone. On the other hand when it comes to changes from one year to another, or environmental conditions which are associated with significant holidays (e.g. 'the mountains are rarely snow-free by Easter, but should be by the 21st of June) we can be expert observers. As a Norwegian saying goes, 'one remembers only the year before' (*Man minnes bare året før*). Perhaps many purported perceptions relate to these yearly variations, not changes in interdecadal means which climate change implies?

Normal Variability

Though a few respondents noted what they perceived to be a trend, the majority believed that their observations could relate at least in part to normal, non-linear variations in weather or cyclical changes:

LNG: "I don't believe that there is a linear development, it goes in cycles."

Fisheries: "These changes may be part of a natural cycle, but they go so fast now, and we can't adjust fast enough to keep pace."

Fisheries: "I am very convinced that humans are causing climate change. But then there are natural cycles occurring on top of this change. The Earth has never been constant, and there have been huge changes before, but they haven't changed overnight like they do now."

Finnmark's weather is remarkably variable. Overarching, powerful region-wide climatic patterns like the Atlantic Multidecadal Oscillation, the North Atlantic Oscillation and the Arctic Oscillation all interact with the local climate. In addition, Finnmark's proximity to frigid Arctic seawater and weather systems, its coastal and inland alpine plateau landscapes, and the warm Gulf Stream all combine to make its climate extraordinarily unstable. The Saami know this better than most and have a saying which describes it well: **'**one year is not another's brother' (*Jahki ii leat jagi viellja*). Here, unusual weather events are not the exception but the norm.

In light of this, if climate change is occurring individuals would have to filter out the extraordinary fluctuations of what might be called a typical state of atypical weather in order to discern the trend of say, temperature or precipitation increase. Furthermore, this is assuming there has ever been a stable state in this region for any length of time, an assumption which was shown in section 1.2 to be dubious at best. Finally, the perceiver would need to spend considerable time in the area to have first witnessed the variation and then discern a trend. Though the majority of respondents from all industries were from Finnmark, few had their roots in Hammerfest as they had moved to the region in pursuit of work. Many in the LNG and tourism industries in particular had come from other parts of Finnmark, and even if they had noticed a change in one or another environmental variable, they may have simply discounted it as common to their new home.

All in all, the ability to actually 'see' climate change is suspect. Indeed, this is a feat that even climate scientists struggle with as they try to detect the linear trend of climate change which is seen as 'camouflaged' within the 'noise' of natural variation and the cyclical trends of the various oscillations (NPI 2011: 24). This is not meant to sell the human senses short, but perhaps the ability to see most climate changes, as defined earlier, is not like seeing the phases of the moon, but is more akin to finding Uranus in the night sky with the naked eye; it can be done, but requires the right timing and weather conditions, acute vision and knowledge of exactly where to look.

Confirmation bias

A challenge with qualitative research is that the objects of study are social individuals – whose behavior continues to frustrate any attempts to include them in some overarching

Newtonian-like model of cause and effect. Unlike objects like apples and forces like gravity, people act unpredictably based on their subjective understanding of the world. A consequence of this lack of objectivity is that all individuals experience and understand the world through the lens of their own bias. One such bias in particular that may have affected the responses of interviewees is that of *confirmation bias*, referring to the "tendency to interpret new evidence as confirmation of one's existing beliefs or theories" (Oxford 2015b). The risk implied by this bias is that respondents who carried a particular belief about environmental change, say, sea level rise, would accept only evidence that coincides with this belief and reject that which does not. Thus, the perceptions of two fishers working side by side on a boat could be quite incongruent if one accepts climate change and the other repudiates it. Respondents may only be seeing what they want to see.

Weber (1997) researched this phenomenon in relation to farmers' perception of climate change, and found that they were likely to distort their memories of past precipitation in light of their belief regarding climate change, either in favor or against. Yet importantly, the degree of error from the actual precipitation data was equal on both sides for those who believed in climate change and those who did not. Thus, as long as the sample included respondents with opposing beliefs, their respective bias could to a large degree cancel one another out and align with actual precipitation data (Weber 2010). In addition, the study did not comment as to causality - that is, it did not address whether observable impacts first caused the belief in global warming, or if prior belief shaped their perception, only that they were correlated. In another study covering a similar topic Myers et. al. (2012) showed that both processes occur, with neither having a more predictive capability than the other.

Though confirmation bias likely has some effect on both the respondent's experiences and responses, it is important to note that every respondent stated a firm belief in climate change. This means that the same confirmation bias, at least in this regards, should be present in all industries and cannot therefore account for the incongruity in perceptions found between industries. Moreover the degree of belief was seemingly consistent across industries as seen in the selected quotes below:

Fisheries: "I am very convinced that humans are causing climate change... The Earth has never been constant, and there have been huge changes before, but they haven't changed overnight like they do now. We shouldn't help these cycles reach catastrophe."

Herder: "Climate change is extremely depressing, I wonder if we have just a short time left on Earth. It goes so fast… It's an emergency, it's a rush!"

Tourism: "Climate change is anthropocentric, though it may be a little bit of natural cycles. But it goes so fast now."

LNG: "All research shows the world is getting hotter and it's likely our fault."

Mining: "The big CO2 emitters in the world, both people and industries must be addressed."

Thus, confirmation bias may explain how certain individuals in the sample allegedly perceived more than others, as some may have simply been looking for these changes. However it does not seem to hold any predictive value in who sees what. Perhaps beliefs are not the only social elements guiding perception? Myers et al. (2012) contend that "evidence that is consistent with the desired *attitude* is accepted at face value, while conflicting evidence is *ignored*, *dismissed*, or subjected to *critical review*" (p343, italics mine). Here the word 'attitude' is used instead of 'belief.' Could certain respondents have a different attitude towards climate change despite their belief in it? Mining and LNG industry respondents certainly displayed a greater tendency to dismiss personal experience and critically reflect upon evidence:

LNG: "I've lived [here] my whole life. I can't say I've noticed any changes, I'm sure there is good statistics on this. Sure, I recall that when I was around 15 all the winters were white with lots of snow, but can't say this is actually how it was. I recall lots of hard winters, but this is just my subjective memory."

LNG: "I have studied all these things in university, of course. I am familiar with [the increasing temperatures argument], but cannot say I am completely in agreement with it. Last year we had enormous amounts of snow, and it was cold. I think the weather in Hammerfest changes a lot, so it's hard to say what a trend is."

"…you must remember that Hammerfest is not typical Arctic. Those reports refer more to permafrost areas or sea ice regions... Here these changes have a big effect. Hammerfest isn't in such a change-zone"

LNG: "The Arctic is large. These are very large changes I suppose. I am a bit skeptical as to where those measurements were taken from, and how they factor into larger cycles."

Questioning subjective experiences, preferring empirical data and critically evaluating sources may have been the result of their educational training, whereas in contrast the herders and fisheries respondents were more prone to take the evidence I provided at face value, or at least without criticisms. Positive associations with climate change were also especially common among LNG and mining industries, and were also present in the tourism industry:

Mining: "People will likely be happy with a warmer climate here."

LNG: "...here we even get happy that its getting warmer!"

Tourism: "I don't mind if it gets warmer here in the North, so long as it doesn't imply others have it worse. It has been fantastically warm here lately!"

Individual attitudes, values and worldviews have been recognized by Weber (2010) as fundamental to understanding individual perceptions and responses to climate change. Difference in beliefs and attitudes quite likely play a part in explaining the difference identified between industries, though the data collected during this research is insufficient to explore their role in greater depth. What can be said based on this sample was that, for whatever reason, LNG and mining respondents were more likely to employ critical thinking and have more ambiguous attitudes towards climate change than the other industries, despite similar beliefs in climate change.

Climate Change vs. Environmental Change

The qualitative findings of this report provide support for the claim that communities on the frontlines of climate change are perceiving changes, yet falls short of being able to assert whether or not the changes perceived are in fact related to climate change. At most it can be argued that individuals can perceive variability, but not the trend, and their perceptions may be biased by their existing beliefs and attitudes. At first glance this contention seems rather benign, as individuals across the globe are undoubtedly registering changes to their environment of one sort or another. Perhaps actual perception of most climate changes are nearly impossible, or at least at this point in its development. Yet just how important is the distinction between climate change and environmental change in terms of understanding community vulnerability and adaptation?

If climate change is a statistical trend spanning decades and even centuries, the trend is built upon individual data points accumulating over time. Each data point is an abstraction of one parameter or another, and represents measurable changes both large and small to the environment. Berkes (2007) argues that the major impact of climate change will not be the average increase in the annual temperatures or precipitation, but rather will manifest itself in singular, irregular events (Berkes 2007: 8). If this is valid, then it is entirely relevant to examine how individuals perceive such events and changes whatever their cause, to what degree they are vulnerable to them, and their capacity to and manner in which they adapt to them. Climate change trends simply reflect an accumulation of these changes large and small over time.

In sum, this section has explored the possible biases and errors present in the respondents' accounts of changes perceived. It then established that while all respondents claimed a belief in climate change, they had different attitudes towards it, whereby respondents from the LNG and mining industries were prone to critical reflection and optimism and fisheries and herders were not. The next section will continue by exploring whether these perceptions are linked to vulnerability and adaptation.

5.1.1 Perception's Link to Vulnerability and Adaptation

The linkages between perception, vulnerability and adaptation have been identified in numerous recent adaptation studies. Adger et. al. (2009) claims, albeit somewhat in passing, that perceptions act as a trigger to adaptation and determine "whether and how" adaptation takes place (p346). He then elaborates upon this further, referring to findings which suggest that perception to one's vulnerability must precede adaptation: "…in situations where no risk is perceived, little if any action to adapt is undertaken" (O'Brien et al. 2006, as cited in Adger et al. 2009: 346). Other research has found similar associations, whereby having personally experienced the effects of global warming has been strongly associated with higher perception of vulnerability and adaptation motivation (Myers et al. 2012).

The responses of my interviewees support the above claims, as outlined in chapter 4.1.1. Yet how these phenomena interact remains somewhat obscure. In most instances, a stated perception was also followed by an experience of vulnerability to the change, and often by a follow-up action in adaption to it. The direction of causation here, however, is not clear. It would stand to reason that those who adapt are those who first believe themselves to be vulnerable, as suggested by O'Brien et. al. (2006). The fish purchasing-station owner and the LNG engineers, for example, acknowledge the threat that sea-level rise poses to their infrastructure and implement measures to safeguard it, while reindeer herders need not take any such course of action as they are not vulnerable to the hazard in the first place.

But where does perception fit in to this order? Perhaps while perception of actual change could occur at any point in this chain of events, perception of its possibility must precede adaptive action. For example, the fish-purchasing station owner in this sample first observed waves increasingly battering the loading dock and responded by raising the dock (Perception > Vulnerability > Adaptation). The LNG plant designers on the other hand, did not perceive the threat first-hand at all, yet they adapted their design in response to their vulnerability all the same based upon their perception of the risks associated with it. Thus according to this logic it could be said that perception, whether of the actual change or of the risk it carries, acts as the trigger to adaptation described by Adger et al., (2008).

With the above in mind, the next section will examine the different types of relationships found between perception, vulnerability and adaptation within the industries in this sample.

Perception's Role in Relation to Vulnerability and Adaptation

It has been argued that perception has a primary role in initiating adaptation. Yet it is clearly not quite so straight forward, as people do not act on everything they perceive. What follows are 4 combinations of perception, vulnerability and adaptation found in this sample which can further shed light on how each industry is situated with regards to environmental change.

1. **Anticipatory or Reactive Adaptation**

   Perception + Vulnerable → Adaptation

2. **Unable to Adapt or Denial**

   Perception + Vulnerable → No Adaptation

3. **Unaware**

   No Perception + Vulnerable → No Adaptation

4. **Invulnerable**

   No vulnerability (Whether or not change is perceived is irrelevant to their industry, and subsequent adaptation is unnecessary).

Figure 5 - Perception's Role in Relation to Vulnerability and Adaptation

The first combination 'Anticipatory or Reactive Adaptation' refers to those who perceive changes, are vulnerable to them, and initiate adaptations as a result. Fishers and herders from this sample fell under this category, as they had perceived the majority of the changes, identified themselves vulnerable to several and had adapted in turn. Yet despite their individual perceptiveness they are far from secure from climate change. For the reasons listed above, their deep embeddedness in complex ecosystems and economies implies a high degree of vulnerability to unpredictable ecological and social

variables beyond their control, many of which may remain unperceived altogether. When these unforeseen changes do occur they will likely be among the first to see them, but the industry as a whole may be taken completely unawares.

The second combination 'Unable to Adapt or Denial' refers to those who perceive changes and are vulnerable to them, yet for whatever reasons engage in no subsequent adaptation. Tourism respondents had perceived adverse climatic conditions affecting transport by land air and sea, leading to trip cancellations and consequentially fewer tourists. As tourists are the basis of the industry, a shortage of them produces a large impact on its economic viability and provides few possibilities for adaptation. In these times only coping strategies are employed, such as tour cancellations, increased operating hours during good weather, or temporary lay-offs. Fishers from the sample may also fall under this category with regards to perceptions of warmer sea temperatures, or at least knowledge of it, and the suggestion that the arctic cod are slowly moving north-eastward towards Russian territory, as well as with regards to their vulnerability to Arctic sea-ice loss. These changes have not yet forced fishers to change their strategies in response, but they expressed anxiety about the possible effects these may have on their livelihoods.

The third combination 'Unaware' refers to those who, though vulnerable to a change, do not perceive the change underway and therefore do not adapt in a timely fashion. Sometimes a hazard is nearly impossible to anticipate before it strikes, as was the case with the reindeer herding industries in Sweden and Norway following the radioactive fallout from the Tjernobyl accident. Then there are hazards which are known by some but not communicated properly to those who will be affected. The vulnerability of fisheries to ocean acidification may be seen as an example of this, whereby respondents had little to no knowledge of this phenomenon or its possible implications. This is a change invisible to the naked eye, and had not yet resulted in visible reductions of ocean species. Should acidification continue unchecked the fisheries industry will be the first and hardest hit, with little recourse in terms of adaptation short of catching organisms that can survive in high pH water or going ashore and engaging in land-based fish farming. The lack of direct experience with regards to this change have apparently left a 'wait and see' strategy, though in the fisheries industry inaction is arguably not the most prudent course of action. Unlike the tourism and herders industries, fisheries

depend upon significant investments in infrastructure, fishing vessels and equipment which cannot be upgraded overnight. Any dramatic change to the fish stock in the Barents Sea will require similarly dramatic upgrades to the infrastructure and fleet, and this will take time and capital.

The fourth and final combination 'Invulnerable,' in all combinations with perception and adaptation, implies no risk. Whether one perceives changes or not, adaptation to them are unnecessary if one is not first vulnerable to some degree. The Mining industry alone stands out as virtually invulnerable to every change identified by the NPI report.

The above discussion has identified and explored the relationships between the key variables of this research - Perception, Vulnerability and Adaptation – and provided examples from the sample where these combinations can be found. As a result of their perceptiveness and vulnerability, the industries are differentially equipped to adapt to environmental changes. Though interesting, it does not explicate why respondents from whole industries were largely unperceptive of the changes identified in the NPI report. Respondents in this sample from the traditional industries (fisheries and herders) were by far the more perceptive. Moreover, they had reportedly implemented numerous reactive adaptations based on current experience with environmental changes. The LNG industry respondents on the other hand had personally perceived virtually none of these changes, yet had nonetheless implemented a number of anticipatory adaptations based on expected environmental changes.

Why could some respondents provide lengthy, personal accounts of virtually all changes while others could not claim to have seen the slightest evidence of the same changes? The next section will explore perception in greater depth, with the aim of illuminating the significant difference found between the various industries respondents' perceptiveness.

5.1.2 Experiential vs. Analytical Perception

Thus far focus has been placed upon one type of perception, that which is experienced with our senses. The fishers and herders in particular appeared to employ their senses most regularly and effectively, and were able to provide numerous accounts of perceived changes to their environment. Then what of the other industries? Does this

suggest that billion-dollar industries like LNG and mining are operating blindly in their environments? Clearly not, as this would represent a colossal financial risk. Though the employees themselves did not directly perceive environmental changes, their respective industries acted as though they were seen. Take the following examples:

LNG: "All these threats are covered for in HMS and planning phase."

"We have prepared for all this [infrastructure vulnerability] - storm wall all around, produce our own energy, dock set for sea level rise, etc." [43]

In order to minimize risks associated with environmental hazards these industries 'perceive' historic, current, and projected environmental data – the very abstractions that many identify as the cause of our failure to act - and base their climate change adaptive strategies upon them. How does this form of perception weigh up against that done through the senses? A closer examination of the various modes of perception is in order to shed more light on the dissimilar findings relating to industry perception.

Weber (2007) suggests that we learn through our faculties of perception, and that there are two ways in which we are able to learn/perceive – through experience and through analytical descriptions (and through combinations of the two). *Experiential learning* refers to information we receive from our body's primary senses: vision, hearing, smell, taste, and touch. *Analytical learning* refers to information received through a variety of channels containing texts such as words, images, sounds and/or gestures.[44] This section will outline Weber's two types of perception in greater depth, and examine how they may be used to understand the perception incongruity found between industries in this study's sample as well as how they relate to adaptation.

Experiential Perception

Weber identifies experiencing as our primary/primal system of perception, one which we share with other members of the animal kingdom, and goes on to describe it as follows:

43 Hovelsrud & Smit (2010) suggests that Snøhvit did not account for projected sea level rise, only historic rise and storm surge maximums. (p42)

44 These texts are not meaningful ipso facto, but are instead abstractions that serve as references to socially agreed upon conventions.

> [The experiential system] teaches us, for example, to dislike food eaten just prior to symptoms of food poisoning and to avoid foods of similar taste or smell in the future. [It] is intuitive, automatic, and fast. It maps uncertain and adverse aspects of the environment into affective responses (e.g., fear, dread, anxiety) and thus represents risk as a feeling (Loewenstein et al. 2001). This system requires real world experience as input (e.g., experienced decision makers make better decisions using it than novices), but its basic mechanisms are hard-wired. (Weber 2007: 3)

In their direct relation with a complex eco-system the herders and fishers are daily experiencing the slightest changes to this environment, and through association making judgments and acting upon their perceptions from one day to the next. This perception is not simply a hobby to pass the time; their very livelihoods depend upon it. If the catch was poor in one location at a particular point in time and in certain environmental conditions, the fisher may judge this to be a random event. Were it to occur again under similar circumstances, s/he may judge it prudent to cast the nets elsewhere. Similarly the herder may perceive their herd to be anxious in areas containing certain infrastructure, judge that the infrastructure is the cause of the anxiety, and seek to avoid these and similar areas in response.

In agreement with Weber's description, this sample demonstrated that the time between perception and action can be rapid to near-instantaneous. Fishers recounted how they can and regularly do quickly adjust their fishing strategies depending on ocean temperatures, wind and waves. Herders were also able to alter their herding strategies (e.g. changing composition of herd in terms of age and gender, dividing it into smaller groups, moving to different elevations or areas of the range etc.) depending on judgments relating to temperature, precipitation, wind and availability of forage.

Many of these strategies may have evolved within the life of the individual through experiential learning – through trial and error – and undoubtedly has its uses. Yet when this method is used alone it has numerous setbacks. For example, it risks action based upon faulty judgment with regards to one's fallible understanding of cause and effect and probability. Rare events, for example, have per definition a low probability of occurring and as such do not factor into day-to-day decision making. This can result in greater risk taking as negative consequences rarely occur (Weber 2004, Hertwig et al. 2006). When they do occur, however, the individuals may be taken completely

unawares, resulting in significant losses. Following such a rare, devastating event, the individual may then give more attention to this particular risk than its probability warrants, or what Weber calls "recency weighting." All of the above make learning by experience quite volatile, and may require decades of experience before it attains any degree of reliability (Weber 2010: 2). Fortunately, and perhaps in response to this shortcoming, humans have developed a supplemental form of learning that is able to compensate for the errors in one's own judgments – one that learns from the experiences of others.

Analytical Perception

As outlined above, experiential perception is a basic, intuitive human ability that requires no prior learning in its use, is fast and is automatic (Weber 2010: 3). Weber identifies analytical perception (or processing) as the alternate method of learning and processing information about our world, one which works through:

> …analytic algorithms and rules, including those specified by normative models of judgment and decision making (e.g., the probability calculus, Bayesian updating, formal logic, and utility maximization). It is slower and requires conscious awareness and control. Its algorithms need to be taught explicitly and its appropriateness of use for a given situation needs to be obvious, eg., it does not get triggered automatically. (Weber 2007: 3)

The key advantage of this form of perception is that by collecting data from numerous sources over sometimes very long timespans, it minimizes the potential for error. Moreover, it does not require that an individual experiences anything at all with regard to the factor in question in order to make a sound judgment based on its probability and potential impact. This bypasses the weakness of experiential perception named earlier, whereby rare events may be both unplanned for in advance and given undue weight following their occurrence.

For example, the LNG industry has no experience this far north anywhere on the globe, meaning employees working at the relatively new LNG production plant at Melkøya had virtually no experiential learning to draw upon, but instead employed an abundance of analytical material in the plant's design, construction and operation. They had not weathered many storms, yet had comprehensive precautionary procedures based on risk assessments covering the technical capacities and maintenance of their equipment as

well as routines to ensure the safety of personnel. Since its construction in 2006, an array of sensors and data collection routines have been registering changes in air and water temperature and quality, as well as the health of surrounding flora and fauna. Thus in spite of its novelty, the facility engineers have access to a wealth of historic and current perceptions.

Analytical perception has clear advantages, though requires a great deal more of the perceiver than experiential perception such as: access to precision measuring devices and or other previously collected large datasets as well as an education to understand, analyze and fit the information into whatever form of logic is being used. It is not automatic but must be initiated by the individual or ordered by somebody who sees value in its initiation. Not only does this process require an abundance of time, organizational capability and cognitive effort, but it may also requires a great deal of capital. These requirements make this the more exclusive of the two types of perception.

In sum, two types of perception have been identified, and attributed to being particularly present in different industries; however, it is not quite so black and white a picture as I have painted it thus far whereby individuals employ either the one or the other. Combinations of the two forms of perception are indeed employed, and represent a robust and effective method of perceiving changes to the environment.

Experiential-Analytical Combinations

The errors common to experiential-based judgment identified earlier (e.g. errors in judgment, recency weighting) were not identified within the fisheries or herders segments of this sample, but history is surely replete with them as many historical practices have over time proven themselves maladaptive and been abandoned (Berkes & Folke 2000: 2). Yet the traditional livelihoods have thousands of years of continual operation to attest for their sustainability and it does not stand to reason that herders and fishers employ volatile experiential perception, whereby each individual learns by trial and error, as their sole means of instruction. Indeed, these industries are able to draw from generations of experience, acquired and tested to form a body of knowledge commonly referred to in adaptation research as Traditional Ecological Knowledge (TEK).

TEK: TEK can be seen as a "library of information" on how to adapt to dynamic changes in complex systems (Gunderson et al. 1997, as cited in Berkes & Folke 2000: 9). Berkes & Folke provide the following definition:

> [a] cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. (ibid: 2)

TEK in the case of the herders and fishers evolved over a time when harvesting food required little or no input. The reindeer 'simply' needed to find forage growing wild, and the fish were 'simply' there to be caught. Lacking modern technology and infrastructure, their livelihoods were entirely dependent upon sustainable practices, and their success required that they not cross the various thresholds related to the particular stock (Holling et al. 1998). In line with this, TEK has also been dubbed "resource management from a resilience[45] point of view," due to its virtue of encouraging diversity of strategies and resources for livelihood security and its ecosystem perspective which includes room for feedbacks and unintended consequences (Berkes & Folke 2000: 9).

Just as the scientific method is concerned with repeatability and predictability, so too is TEK (Freeman 1992). Similarly, as the aforementioned analytical forms of perception collect data from numerous sources over sometimes very long timespans, so does TEK as it collects observations and knowledge from multiple generations; and as a result of this large empirical basis it too minimizes the potential for error. This could explain the fishers and herders faith in their ability to adapt to climate change, as their industries have faced dramatic challenges in the past that have been overcome. Hovelsrud & Smit (2010) observe that the average decadal variation in ocean temperature in the eastern Barents Sea during the 20th century is roughly within the same range of 1-2 degrees Celsius which is expected within the 21st century. Likewise with regards to herders Tyler et al., (2006) suggest that many climate change events during the last 100 years were at least as great as those projected in the next 30 years, and virtually all projected changes are not unprecedented in the history of reindeer herding. All else being equal,

[45] Resilience is 'the amount of change a system can undergo and remain within the same regime – essentially retaining the same function, structure, and feedbacks.' (Source: Walker & Salt, 2006)

TEK could be sufficient in informing fishers and herders in how to respond to these projected environmental changes at least for the remainder of this century.[46]

TEK represents a rich, time-tested and empirical source of adaptive knowledge and has many advocating its inclusion into other adaptation research (e.g. Freeman, Berkes et al.). There are several examples (e.g. McCay & Acheson 1987, Berkes 1989, Freeman et al. 192) where TEK was shown to outperform scientific management of resources.[47] Yet the clock is ticking, and if TEK is to be included into mainstream research it should preferably be undertaken sooner than later as it exists primarily in oral form. In the mean time, the industries which have collected and hold this information are struggling to recruit future generations. The average age of fishers in the area is nearing 50 years old, and without continual recruitment and connection between the old and the young, this knowledge will not be passed on (Hovelsrud & Smit 2010: 47). Similarly in Hammerfest, fishers have expressed concern that the next generation is being lost to the petroleum industry, as the working conditions and pay here are seen as preferable to the low paying and harsh conditions of the traditional livelihoods (ibid). TEK's fading or outright disappearance would warrant a great loss to the fisher's and reindeer herder's adaptive ability and safe operation at sea and land. It is therefore fortunate that in addition to TEK, the herders and fishers have access to modern scientific observations.

Scientific Observations: The marriage of disparate knowledge systems such as TEK and scientific observation has been argued by some (Berkes 2007: 8) to be favorable as this balances their respective flaws and increases the overall capacity to learn. For example, climate change research has produced vast data sets and projections with powerful predictive abilities for entire regions, yet efforts to downscale these findings to a single point on the globe continue to be a challenge. It is here that a combination of TEK and scientific observation can be quite useful, as Berkes (2002) observes:

> …community-based monitoring and indigenous observations …fill in the gaps of global science and provide insights regarding local impacts and adaptations. (Berkes 2002, as cited in Berkes 2007: 290)

[46] In the sections which follow I will argue that all else is not equal, as modernity has brought with it some unique challenges.

[47] Though there are likely situations where the opposite was true which were not identified in this report.

Due to the requirements of time, education, and capital mentioned earlier, the average herder or fisher will not collect and analyze scientific data appropriate to their industry. Instead, organizations acting on their behalf are able to provide these services. Norwegian state agencies like the Ministry of Climate and Environment and the Ministry of Trade Industry and Fisheries, the Saami Parliament (*Sametinget*), and unions such as the Norwegian Fisherman's Association (*Norges Fiskarlag*) not only regularly fund, produce, and disseminate reports, but also influence action on the ground through recommendations, guidelines, quotas and restrictions based upon these scientific findings.

In sum, a combination of analytical knowledge of an environmental change and its potential implications along with personal experience of the change itself may be superior to perception at just one level alone, resulting in greater perceptiveness and motivation to adapt. As such, knowledge acquired from a combination of analytical and experiential perception may serve as the superlative basis with which to build adaptation efforts upon. Having explored the different types of perception, analytical and experiential, as well as their combinations, the next section will endeavor to describe a possible explanation for the difference between industries with regards to respondents' perceptiveness.

Industry Perception Difference Explained

To summarize the above arguments, LNG and mining respondents primarily have access to analytical perception while fishers and reindeer herders are equipped with personal experience, TEK, and scientific observations. Clearly, the latter represents a powerful mix of perceptive tools, especially adept in identifying changes at the local scale.

As analytical perception requires cognitive effort as well as access to data, those who are not working with climate change specifically would not be expected to use this form of perception in a sufficient capacity to obtain confirmation of changes to their environment. Working largely indoors and virtually non-dependent on environmental factors for their well-being, experiential perception of environmental change is unlikely in the LNG and mining industries. Neither do these industries hold a form of TEK of what normal conditions should be.

The findings outlined above support the argument that individuals working outdoors and in an industry that is dependent upon a certain range of environmental conditions are more perceptive of environmental change than the other industries explored. Yet not everybody is out in the elements making their living - much work is now performed indoors. Some have argued that as a result of modern lifestyles and technologies modern societies have become domesticated, and have abandoned environmental knowledge as a non-issue (Rayner 2003, as cited in Amundsen 2014: 24). It has also been suggested that this has lead to a disconnect with nature in general, and a more blasé attitude towards protecting it (Hovelsrud & Smit 2010). A generous estimate puts just 20% of Finnmark's workers outdoors, though this includes in addition to farming, fishing and reindeer herding all employees of the petroleum, mining and construction industries, many of whom work in an office (see Appendix 1 - Finnmark Employment (Source: SSB). Highlighted segments are from top to bottom 01-03 Farming, Forestry, Fishing and Herding; 05-09 Mining, Oil and Gas and 55-56 Accomodation and Serving. Used to identify segment of population working in the industries used in this study. Talking weather around the office canteen may be a relic of our onetime reliance upon climatic conditions for our very survival, but today they seem virtually irrelevant to the livelihoods of most.

In light of these conditions, perhaps the mining and LNG industry respondents' lack of personal, experiential perception is inevitable? Though this may indeed tell part of the story, it is by no means the unavoidable result. A preference for analytical learning does not preclude one's senses from experiencing the world as well. Research has suggested that when scientists actively mix experiential with analytical perception, the results on their perceptibility are dramatic (Dunlap and Saad 2001, as cited in Weber 2007: 1). Climate scientists, for example, engage their analytical perception with the sole task of identifying these changes' historic path and predicting their future trajectory. In addition to the analytical, these researchers are often personally exposed to the experiences of climate change as their research takes them to places like the Arctic or low-lying island states where such changes are dramatic and perceptible (Weber 2010: 4). Indeed, climate scientists in particular are identified as showing far more concern about climate change than the average citizen or government official (*ibid*). Perhaps as new-comers, the well-educated engineers of the LNG and mining industries only need enough time in the Arctic to acquire sufficient experiential perception, and in so doing

create their own TEK of sorts. It is conceivable that then the differences between the industries may not be so great in this regard.

Meanwhile it seems that when it comes to perception, the fishers and herders have everything going in their favor. Firstly, they are veteran users of experiential perception and depend upon it for their livelihood success as they are outdoors experiencing environmental changes day after day, year after year. Secondly, a long and rich TEK informs them on normal conditions and guides their actions. Finally, access to up to date scientific data, projections, and recommendations is included alongside the other forms of perception.

In sum, two key modes of perception have been identified, analytical and experiential, each with their own strengths and weaknesses. Numerous combinations of the two are also to be found, and the industry difference in perception of environmental is suggested to be the result of the types of knowledge the respondent regularly accesses or has access too. This section will now conclude by exploring the implications of analytical and experiential perception on adaptation.

Analytical and Experiential Perception Effects on Adaptation

Earlier in this section I established that adaptation to environmental change does not require that those vulnerable to it first perceive the change itself, but instead that only the perception of its possibility was required. This was used to explain the occurrence of numerous adaptations taken by the LNG industry, despite respondents from this segment's apparent lack of personal experience with environmental change. It was also established that the two types of perception are not equal in their requirements of the perceiver, and this section will briefly argue that neither are their effects on adaptation identical.

As mentioned earlier, Weber (2010) suggests that experiential perception is fast and automatic, providing an easy to use and accessible method of knowing one's environment. Contrarily analytical perception requires at the least cognitive effort and intention, though may also require a previous education and access to data and measurement devices etc. When faced with information by both forms, Weber argues that individuals are more likely to prefer their own personal experiences over abstract

statistical summaries (ibid.). Myers et al. (2013) agree, asserting that abstractions "make for pallid education, and are less convincing than the vividness of personal experience" (p343). In short, experiential perception is seen as a far stronger motivator, encouraging immediate action to a perceived vulnerability or opportunity. This is a useful perception to act upon for industries with little to no infrastructure, whereby their relative mobility allows them to respond to changes at the drop of a hat; however, as a result of experiential perception's basis in current changes, subsequent actions may tend towards uneven and short-sighted coping strategies, and in the worst case maladaptations.

Analytical perception, on the other hand, provides a far more reliable account of vulnerability and the likelihood of various hazards resulting in harm or loss. As such, it is well-suited for anticipatory adaptation and the long-term planning required of industries which depend upon significant infrastructure which cannot easily or cheaply be retrofitted should conditions suddenly change. Yet perceptions of this nature must be ordered and financed by some individual or group, meaning that vulnerabilities which are not particularly looked for may not be perceived at all. Unforeseen changes can then have dramatic impacts on infrastructure and the industry's activities.. Moreover analytical perception is a much slower process, and industries depending upon it may struggle to implement both reactive and anticipatory adaptations in a timely manner.

Hammerfest is perhaps rare in that it is home to both robust traditional industries with continual experiential perception of their environment and rich TEK, as well as advanced industries which access and create reliable analytical information. The support and inclusion of its experiential perceivers in the fisheries and herder industries, for example, can have positive effects in other industries and sectors by providing locally relevant information regarding environmental change. Similarly, the information currently being gathered through the various industries and sectors employing analytical perception can in turn provide greater forecasting and risk-analysis capabilities to the traditional industries. Access to knowledge of both sorts, experiential and analytical, may be one of Hammerfest's greatest assets in terms of its adaptive capacity.

This concludes section 5.1 'Perceiving Change,' and I will now continue by analyzing Key Finding 4.2 'Identity.' As stated earlier the abstract, imperceptible nature of environmental change has been touted as a key explanation as to why so little adaptation is occurring globally at all scales. Other adaptation research has argued that individuals tend not to respond to concerns that they do not perceive as "immediately and personally relevant" (Moser and Dilling 2004; Paton et al. 2001, as cited in Adger et al. 2009: 347). Yet if climate change continues unabated, these changes will threaten "deeply held cultural, historical or ethnic *identities*" (ibid: 347. Italics mine). The following section will explore the implications identity may have on adaptation based upon this report's findings.

5.2 Identifying with Livelihood

As argued earlier, much of the mainstream discourse surrounding environmental change places a strong emphasis on utilitarian metrics, and fails to recognize the subjective experience of individuals and communities (Adger et al. 2009). Threats to identity posed by environmental change are often indirect and cumulative, making identity more likely to be "invisible" in environmental policy making (Turner et al. 2008, as cited in Adger et al. 2009). As a result of this omission, adaptation measures designed at the systems level will ignore the conditions present at the individual level, and as such may do more harm than good (Coulthard 2012, as cited in Amundsen 2014). At the individual scale the things that people identify with, and the losses they fear or experience when these things are threatened, degraded or destroyed have very real implications in terms of adaptation (Adger et al. 2009). In other words, the things that individuals identify-with will have significant implications upon how they act.

Chapter 4.2 outlined the marked difference between industries with regards to workers' emotional attachment to the job. An examination of industry-specific attachments to livelihoods revealed a consistent response within industries that was identical almost down to the letter. Does each industry attract a certain type of individual with particular attitudes towards work? What role does education level play, or one's family history and tradition? Identifying the 'why' or what may be the actual cause lying behind the apparent correlation of livelihood identification by industry is beyond the scope of this

research. Yet inferences can be made as to 'how' it may potentially affect the individual's overall adaptability as well as that of the industry as a whole.

The interview guide contained a section which aimed to gauge the respondent's preparedness to respond to dramatic environmental change, and included several questions along the lines of "[i]magine that these [environmental] changes continue and become more and more dramatic, what will this mean for your industry?" and "if you are forced to seek other work or move to another area, what would you do and where might you go?" Although the intent was not to explore the theme of identity, it emerged somewhat automatically nonetheless through many of the interviewee responses. Identity has been noted as a key social factor influencing adaptation motivation and outcomes in other adaptation research (e.g. Adger et al. 2009), and it is therefore unsurprising that it was relevant to this sample as well.

Previous adaptation research has focused particularly on place-attachment and cultural-symbols, which has encouraged both conservation/preservation responses as well as adaptive/mitigative ones (e.g. Adger, Amundsen). Love for country and culture did not shine through in my sample, even though Norwegians generally are known to revere both; however, many interviewees referred to either a strong connection or relative detachment to their livelihood. As with perception, the degree of identification-with livelihood was found to be differentiated by industry. Moreover, livelihood identities represents a social factor which has largely remained ignored in adaptation research, and a factor which I contend will have significant adaptation implications if it does not already.

5.2.1 Identity and Vulnerability

Adaptation researchers argue that attachments serve as a powerful motivators to maintain whatever attributes of a place or symbol that are valued (Amundsen 2014, Kaltenborn 198, Stedman 2002).

Attachment to place has received particular attention within climate adaptation research (e.g. Amundsen 2014, Adger et al. 2013), and is defined as:

> …a concept that describes the level of connection that individuals have with the people and environments in which they live. The concept…describes the identity created around a settlement or place, the sense of pride associated with belonging to a village, town or city, and the friendships and networks that exist within them. It contributes to individual and community well-being and quality of life… (Adger et al. 2013: 113)

Adger et al. (2013) goes on to suggest that place attachment is more likely to result in pro-environmental behavior, a contention which has broad consensus among several other researchers (e.g. Marshall, N. A., Fenton, D. M., Marshall, P. A., as cited in Adger et al. 2013: 3). Similarly Amundsen (2014), while conducting fieldwork in nearby Vesterålen, found that a strong place attachment was a powerful motivator, one which enabled individuals to take action and fight for their community's well-being and which had significant implications for the community's overall resilience. Furthermore, research in psychology suggests that place attachment is one of the three most important predictors[48] of one's engagement with climate change (Scannell & Gifford 2013, as cited in Amundsen 2014). In short, an abundance of adaptation research suggests that place attachment can motivate individuals to engage in causes where they perceive the place as threatened or vulnerable. This proposed relationship can be simplified by the following formulation[49]:

Formulation 1

Strong Identity + Threat to Identity = Engagement

Returning back to the current research's sample, place attachment can be inferred from several responses within the fisheries and herder industries which suggested that moving from their home due to environmental changes was inconceivable or would be as a very last resort. A lack of strong place attachment appeared in numerous responses

[48] The others being gender (female) and locally relevant information (Scannell & Gifford 2013, as cited in Amundsen 2014: 41)

[49] Note: I use identity and attachment somewhat interchangeably. The formulation is not meant to represent any mechanistic formula, only a general relationship advocated by several adaptation researchers.

within the tourism, LNG and mining industries that had no qualms with the notion of changing residence.

On the whole, attachment to place was not explored in depth during interviews; however, attachment to livelihood was. Hovelsrud & Smit (2010) note that attachments to either place or livelihoods will influence individual's "motivation for, and intensity in" adapting to changes (p331). I suggest that these attachments are an indication of the degree to which the respondents' livelihood or place are a part of their identity or in other words, the degree to which they identify-with them. Recalling the definition provided earlier, place attachment referred to a *connection to* and a *pride in* one's place which results in *individual and community well-being*. Perhaps identification-with livelihood has similar qualities? Fishers and herders certainly alluded to a connection, a pride, and well-being associated with their livelihood. A review of the sample will explore this possibility.

Strong Identification-with Livelihood

In section 4.2.1 a strong identification-with livelihood was identified within the fisheries and herder industries, whereby interviewees responded with emphatic reservations against pursuing a new line of work if their current industry failed due to the many threats posed by climate change. Yet how did they respond to questions regarding their engagement with climate change and "environmentally friendly" behavior?

Fisheries: Expressing vulnerability to 6 out of 7 changes (see section 4.1.2), fisheries were the most threatened industry in this sample. Using the aforementioned formulation, we find fishers with strong identification-with their livelihood, and who face significant threats which are largely related to global warming (e.g. sea ice melt, species redistribution and migration, ocean acidification) and waste management (e.g. environmental toxins). Engagement with these issues could therefore be expected to be directed towards GHG reductions and waste disposal. A closer examination of the fisheries sample found that environmentally-friendly behavior was somewhat evident in terms of waste disposal. While one fisher mentioned recycling, several respondents from the industry named no longer dumping garbage in the ocean as their primary

environmentally-friendly action[50]. Engagement with global warming, however, was not evident. Thus, the aforementioned formulation gains only partial support within the fisheries industry, where engagement was weak in spite of what I argue to be a strong identity facing major threats.

Herders: As stated above, the herders too revealed a strong identification-with their livelihood. Yet they perceived themselves as vulnerable to just 2 of the 7 environmental changes, (Environmental Pollutants and Warmer and Wetter). Although the sample size was smaller in this group, the respondents were found to be relatively engaged in environmental issues. One respondent felt especially concerned with and vulnerable to environmental pollutants, and had considerable engagement with the issue both within her profession as well as an activist. Another showed similar engagement, responding that reindeer herders 'save the environment constantly – it's our job. We depend on clean grazing areas so we leave everything as pristine as we found it or better.' Thus, the herder respondents of this sample give support to the formulation.

In sum, strong identification-with livelihood was found correlate with significant engagement with climate change and environmentally friendly behavior amongst the herder respondents and to a lesser degree in the fisheries. Although the sample size is too small to make any definitive conclusions on the matter, as the most vulnerable segment the fisheries industry was not especially engaged in environmental issues. This is not to say that the formulation derived from other adaptation identity studies does not apply to the fishers. Despite their admitted vulnerability to the changes from the NPI report, their biggest concern was vulnerability to global market fluctuations. Perhaps it is a question of degrees, where their identification-with livelihood may not be so large after all, or perhaps respondents do not experience their industry as immediately threatened by climate change. Lack of information or challenges in connecting the global nature of climate change to local behavior may also play a role. For fishers, identification-with livelihood may very well play a similar motivating role as that suggested by other researchers, but only once this industry faces greater peril.

[50] This may seem obvious to urban dwellers, but dumping at sea remains a common practice across the world. Moreover, the respondents stated that they stopped dumping due to their perception that a polluted ocean was not good for their livelihood. Thus, though it may not represent a radical engagement with the issue, it still gives a degree of support for the general argument.

Weak Identification-with Livelihood

If we were to invert the above formulation which states identification-with results in greater motivation and engagement with issues pertaining to it, we should expect people with weak livelihood identification would be less motivated and engaged in issues related to this form of identity.

Formulation 2

Weak Identity + Low Threat to Identity = Weak Engagement

LNG and mining industry respondents did not appear to identify-with their livelihood, at least not relative to fisheries and herders. Aside from infrastructure vulnerability, they did not perceive themselves to be vulnerable to projected climate change. One would expect a weak engagement with climate change issues.

At first glance, this anti-hypothesis did not seem to hold water in this sample, as individuals from the tourism, LNG and mining industries were reportedly quite engaged with climate change and environmentally friendly behavior: biking to work, active recycling, and consciously sustainable consumption just to name a few.

Although interesting, this does not paint the full picture as these are all activities undertaken privately – the situation at the workplace is entirely different. While the Snøhvit facility shows considerable engagement in reducing its impact on the environment via carbon trading schemes (as is mandated) and its operators claim it has exemplary performance standards compared to the industry norm, LNG is also an industry with enormous outputs of greenhouse gases. For example, Snøhvit emits 964,000 metric tonnes CO2 annually in its operation (Statoil 2015b), roughly the equivalent of 180,000 cars[51]. This does not factor in emissions resulting from the actual consumption of the LNG. Similarly, while the proposed mining operation is looking into becoming one of the few electrically powered mines in the world, it also plans on dumping two million tonnes of heavy metal, chemical, and uranium laden toxic waste into the fjord annually over a 15 year period.[52] Norway is one of four remaining

[51] Based on EPA (2015) where each car emits roughly 5,1 tonnes annualy.

[52] Havforskninginstitutt 2015.

countries that continue this practice worldwide (along with Indonesia, Papua New Guinea and the Philippines) in spite of being a signatory to the London Protocol (2006) which expressly forbids this practice (Dold 2014).

Such duplicity, whereby respondents refer to acts of environmental stewardship whilst their industry does quite the opposite, can still be explained using the logic of the above formulation. Perhaps it is a question of which identity is threatened. Social theory (e.g. Goffman 1959) holds that we have numerous identities which we employ in various contexts. One can be the permissive and caring parent at home, but a strict and ruthless boss at the office. While the tourism, LNG and mining respondents may not strongly identify-with their industry, they may identify themselves as environmentally responsible individuals, global citizens etc. If so, threats to these closely held identities would lead to the engagement they described at the personal level. At the corporate level however, low vulnerability mixed with no threatened (livelihood) identities made engagement minimal in terms of actual environmental impact relative to the fisheries and herder industries. Aside from those measures mandated by law, other initiatives which aim to reduce the environmental impact of industry operations may be taken to improve environmental credentials and public relations.

In sum, the herders and fishers are argued to hold strong identification-with their livelihoods and are to a degree engaged in environmentally friendly actions to phenomena which threatens their identities. Meanwhile others do not show the same degree of identification-with their livelihood, and though they pursue environmentally friendly behavior on a personal level, similar engagement is not found in their workplaces; however, in terms of adaptation their flexibility may actually increase their adaptability insofar as employment is concerned, as they are ready and willing to change location or employment at the drop of a hat. Fishers and herders on the other hand are much more attached to their livelihoods, a fact which may limit their willingness or the timeliness of their adaptations to environmental change. The next section will explore these possibilities.

5.2.2 Identity and Adaptation

The previous section identified the proposed relationship between identity, vulnerability and engagement found in much adaptation research, and after placing respondents on a

relative scale of Strong and Weak livelihood identification, compared this formulation with the results from this sample. The correlation did not appear to be quite so straightforward, but some evidence was found to support it. In short, adaptation research suggests and findings from this sample support that identity plays a positive role in motivating individuals to fight for what they value. Though this engagement may be valuable in terms of *conservation* of landscapes and traditions, can the same be said of its effects in terms of *adaptation*? Contrarily, what of those with weak identifications-with place and livelihoods? What impacts may their relative detachment have on their adaptability?

Adaptation responses where identity is concerned are perhaps as diverse as identities themselves, but adaptation research has generally lumped responses into one of two camps: 1) identity is often seen as a motivator to act when individuals perceive their particular identity-symbol threatened (e.g. Adger et al. 2013, Amundsen 2014) or 2) events which conflict with established identities can result in individuals systematically rejecting/suppressing the conflictual element, leading to inaction/maladaptation (e.g. Norgaard 2011, Adger et al. 2009). In other words, identity can either motivate or limit individuals' willingness to adapt.

Strong Identification-with Livelihood

Having established that identities serve as both enablers and barriers to adaptation – how might the strong livelihood identities affect adaptation in Hammerfest? The reindeer herding and fisheries industries have been identified as including individuals who have a relatively strong identification-with their livelihood. Yet it is not only the workers themselves whom identify with the industries. Other research in Arctic Norway (Hovelsrud & Smit 2010) contends that natural resource based activities have become highly valued cultural symbols despite their relatively reduced contribution to employment and the local economy, and serve in local identity formation and in people's sense of belonging (Hovelsrud & Smit 2010: 320). Thus, there is likely considerable engagement by both workers in these industries and in the general population to ensure that these industries continue to be defining elements of the region. Indeed, with millennia of local history, they are industries worth fighting for. Yet

projected climate trends will likely challenge the livelihoods of fishers and herders in particular, testing their strongly held identities.

Strong identifications-with and within these industries may motivate both workers and local inhabitants alike to dig in their heels and fight to conserve whatever it is about these industries that they identify with, in the face of great odds. Research by Mishra et al. (2010), for example, found that individuals who strongly identified-with place were more likely to be prepared for expected climate change hazards (e.g. flooding) due to their social and economic investments in that place. Yet conservation and adaptation are two quite different things, and it remains unclear if maintaining the current status quo is desirable or even possible in light of the challenges ahead. While it may be wise to prepare against periodic flooding in some areas, in the previously mentioned mega-deltas rising sea levels may soon require that millions of people give way and relocate; to stubbornly stay put here would be a risky and untenable alternative[53].

Some research suggests that strong identities can in fact stand in the way of individual willingness to engage in adaptive behavior. Adger et al. (2013) observed that individuals with strong identification-with place are reluctant or unwilling to migrate when the need arises (p113). It is not only identification-with place which has been found to result in stubbornness and myopic thinking. Norgaard (2011) explored Norwegian national identities which take pride in the nation's bountiful nature and environmental stewardship. Yet when faced with information which conflicted with this identity (e.g. Norwegian CO2 emission per capita) they experienced a crisis of identity – and ultimately rejected the discourse of Norway as an un-environmental agent in favor of preserving the original national identity. In short, strong identity was argued to limit the actor's willingness to accept alternate discourses and versions of reality, which would necessitate a change in behavior, in order to maintain the original identity.

What happens when it is no longer a question of conserving reindeer grazing ranges from infrastructure or keeping the fjords clean from toxic waste? These issues require

[53] Note: the discussion remains hypothetical when related to Hammerfest. This research did not identify any 'digging in the heels' related to climate change adaptation, and when it did occur it was only in terms of conserving fishing waters and grazing ranges from degradation by other industries.

relatively simple, local actions or provide clear, local targets to rally against. Temperature increase and ocean acidification, however, are global phenomena without simple or local solutions. The projected climate change trends will challenge these identities, and may require a complete restructuring of these industries. Digging in heels today may waste valuable time and limit the adaptation choices tomorrow.

As mentioned earlier, ocean acidification or the migration of the arctic cod out of Norwegian waters may one day make the bulk of the Norwegian fishing fleet obsolete, forcing a transition to other employs such as sea or land-based aquaculture. Similarly continued expansion of civilization may reduce herder's grazing land beyond their ability to cope if they continue with traditional strategies, and may need to be replaced by a form of pellet-fed, penned-in reindeer husbandry. As arguably the most sustainably managed industries in Hammerfest, their prosperity and future viability should certainly be fought for, but with the acknowledgement that they may not be able to continue on as they have before.

Weak Identification-with Livelihood

Relative to the fisheries and herder industries, the responses from the LNG, mining and tourism industries displayed a far greater detachment from both livelihood and place. At the same time, these are the industries that believed themselves to be the least vulnerable to the changes in the NPI report (see Table 2 - The Relationship between Perception, Vulnerability and Adaptation); however, they expressed vulnerability to market fluctuations and regulatory interference which could 'sink' their industry far faster than rising sea levels. Whereas 100 years ago these industries were virtually non-existent in the region, today they represent sizeable employers for Hammerfest's inhabitants and a tax-base for the district. The contributions of the LNG industry to Hammerfest in particular are considerable: it employs 1 in 10 of Hammerfest's inhabitants, has reversed the trend of falling populations and economic stagnation, and lead to an increase in tax revenues from an average of NOK 6 million in 2002 to a staggering NOK 163 million in 2010 (Angell 2014). Thus, the adaptive capacity of the LNG industry is very much related to Hammerfest's adaptive capacity as a whole. In what manner then may their weak identification-with livelihoods affect this adaptive capacity?

With regards to identification-with livelihood, respondents in these industries had little to speak of. Instead they stated that they could easily find work elsewhere if necessary, and that this change would imply virtually no sense of personal loss. Clearly this is advantageous in terms of their individual adaptive capacity. With flexible employment parameters and flexible educations, workers in these industries are well-suited to respond quickly to both economic and environmental changes. If the LNG industry should for whatever reason fail, its engineers would both be sought after and willing to change workplaces. If new industries emerge in Hammerfest in time to replace the old, Hammerfest could retain its human capital.

On the other hand, the relative lack of attachment to place of these workers and resource extracting industries in general would make it an easier choice to move elsewhere should extreme conditions arise, abandoning Hammerfest perhaps when it needs them most. In this sense, adaptive capacity gains from increased budgets and a more diversified economy may strengthen Hammerfest in the short term but not in the long term. LNG and mining are essentially time-limited undertakings, ones which have plenty of options elsewhere. When compared to fisheries and herders who identify strongly with their livelihoods, are vulnerable to both economic and environmental change, and who have no place else to go, the respondents from the LNG, mining and tourism industries and the industries themselves have far greater adaptive capacity.

Adaptation in Finnmark is unlikely to be a question of life and death in the near future. With substantial social and financial capital, its inhabitants will undoubtedly adapt and survive. But the question remains whether adaptation can be seen as successful when it is forced, leaving individuals with battered identities? History is replete with examples where individuals and whole communities lose what they value – whether it be the loss of a cultural symbol such as a traditional local industry that goes belly up, or the loss of the place itself such is the case in numerous dam constructions – the social consequences have been identified as devastating, chronic, and long-lived (Trudelle-Schwarz 1996; Oliver-Smith 1991, as cited in Adger et al. 2009). Cultures are always in a dynamic state, yet when dramatic change occurs individuals may sense that their culture has been diminished or a particular aspect of it has been irrevocably destroyed Adger et al. (2013).

Identification-with place has been explored in much recent adaptation research, and was used to inform the above discussion surrounding identification-with livelihood. The Earth's surface (and what lies under it) has an abundance of social meanings aside from that which is referred to under the term 'place.' Respondents in this sample also referred to land and sea as something less of an emotional attachment, and instead as a more utilitarian commodity which is yearned for, depended upon, and contested (Amundsen 2014). These utilitarian attributes will be used to define and explore the next section's discussion of the social construction of *territory*, and how it relates to climate change adaptation.

5.3 Adapting in Territories

The previous section explored identification-with place and livelihood, and their implications on adaptation. Yet we are not only emotionally attached to land and sea, we require them for our sustenance. Similarly the existence of the primary sector is completely dependent upon these spaces. This section will explore how the varying degrees to which each industry depends on space will have implications on their ability to adapt to changes within these spaces. The concept of 'territory' was employed in section 4.3 to describe this dependency upon and defense of space, and found that Finnmark's land and sea is indeed a limited commodity which is fiercely contested by the various user groups. A range of regulations exist at different scales as to who can do what and where, with the occasional overlapping of territory rights. Whereas 'place' has received much attention, the adaptation implications of space as contested 'territory' is one which has largely been ignored in adaptation studies, yet one which I argue to be a social limitation to adaptation perhaps of greater consequence than identification-with place or livelihoods.

Take for example the herder industry, which requires access to space containing adequate grazing conditions. Territory, like all social artefacts, can be altered, but a reindeer herd requires just the right quantity and quality of space to survive. This is in stark contrast to the nature of identities: an unemployed fisher *can* get a job at a grocery store, even though s/he may not like it. An outdoor enthusiast may be upset about the loss of his/her favorite place, but life will go on. In the case of the herder industry, however, no space equates to no survival. The same can be said of the other industries

as well. Identities boil down to a matter of preference. Although social phenomena certainly have significant impacts on action, they are relatively mutable. Territory, on the other hand, reflects immutable dependency upon space.

As all action occurs in space, so too does adaptation. Earlier a definition was borrowed from zoology, and continuing along that line of thought it seems that the animal kingdom's survival tactics and that of industries are not so different. As space contains the basic elements upon which all species depends, the greater the space the greater access to the resources therein and hence better survival odds. In addition, when conditions change, space allows mobility to alter survival tactics. Yet most species can only survive in a particular space with a particular range of environmental conditions and available resources – their niche – and are encircled by other competing species. When conditions change in an animal's niche beyond their ability to cope, they must either move or perish. Similarly, spatial considerations can make or break an industry, and there is no worse place to be than backed into a corner with nowhere to turn.

Fortunately, Finnmark is enormous. Yet in each industry's endeavor to secure spaces containing their particular resource, their room to maneuver respective of one another becomes more and more limited. Though Finnmark is indeed large, and vast portions of it appear to the uninitiated as uninhabited, desolate wilderness, the overall portrait given by the respondents in this study was that there is virtually no unclaimed space – that the boundaries between and within the industries are maxed out. In this saturated state, territorial gains by one industry will invariably result in territorial losses by another and one industry's adaptations will have implications on other industries. The following pages will examine the territorial uses and implications of Hammerfest's primary sector industries over various scales.

Herder Territorial Adaptive Strategies

As identified in section 1.2, herding and fisheries have been the dominant livelihoods in Finnmark for several thousands of years. During this time, they have virtually had total dominion over their respective territories of land and sea with no other industries or interests to vie for these same spaces. In the case of reindeer herding, movement is seen

as their most crucial adaptive strategy which explains why they require extensive space in order to adapt to environmental conditions:

> The more landscape types one has – that is, alternatives with which to meet different situations – the more secure reindeer pastoralism will be over a longer period of time. Contrariwise, in a uniform landscape without alternatives, one is left helpless when faced with natural changes. (Mikkel Nils Sara, quoted in Paine 1992, as cited in Tyler et al. 2007: 197)

At the local level, individual herders can change locations within their range depending on environmental conditions. They can seek shelter from a storm on the lee side of a mountain or find accessible lichen on the windward side in the winter.

In addition to local strategies, the herders engage in an adaptation strategy that takes them on a 300 km journey with their herd between the coast and the highlands surrounding Kautekeino to the South (see Appendix 13). In the spring they generally move to the coastal regions where dwarf shrubs, birch, willows, sedges and grasses provide rich and abundant nourishment. Then in late fall the herds are gathered again and taken to winter pastures to the south, typically on the alpine plateaus (*viddes*) and taiga birch scrub (Tyler et al. 2007). As identified earlier, one of the greatest threats to winter grazing is thawing and re-freezing cycles, which are more common along the coast than in the mountains (Tyler et al. 2007: 194). The current migration routes of reindeer may therefor be the continuation of the natural migration routes of reindeer, and is seen as a direct adaptation to climate conditions.

On a regional scale, the herders occasionally arrange to "trade snow" with a neighboring district (*siida*), permitting them to enter into their territory to graze within their range. Historically, herders would also enter the grazing lands of Sweden and Finland on occasion following appropriate permissions, though this practice has fallen into disuse.

In addition to territory on land, the so-called Sea Saami (Sjøsamer) engage in fishing and historically sealing. Unfortunately there are few Sea Saami settlements remaining, owing to their early assimilation into ethnic Norwegian society. Yet it is worth noting their unique adaptive strategy which combines both land and sea, whereby maritime activities are mixed with terrestrial agriculture or pastoralism.

Fisheries Territorial Adaptive Strategies

Similarly fisheries respondents revealed numerous adaptation strategies which make use of movement in territory. On the local scale, fishers have established numerous spatial strategies in order to meet changing conditions in the economy, weather and distribution of fish stocks. These include choosing areas protected from the wind and waves during extended stormy weather, going further out to sea when fish stocks seek cooler waters, and more recently by implementing coastal fish-farming.

On the national scale, Norwegian-registered boats frequently move over great distances (often up to 300 nautical miles or more) throughout the Norwegian exclusive economic zone (EEZ) in order to follow the seasonal fish stock migrations. When bad weather conditions prevent them from catching their quota closer to their own port, this flexibility in space can provide an invaluable adaptation strategy (Hovelsrud & Smit 2010: 38).

Finally on the regional scale, larger vessels are able to go much further afield than Norway's EEZ, to the rich fishery protection zones surrounding Svalbard and Jan Mayen, or the small strips of international waters ('High Seas'). Otherwise, at this scale movement possibilities are limited by the national boundaries of Russia to the east and Iceland, Greenland and the U.K. to the west, and the polar icecap to the North (see Figure 2 - Norwegian Exclusive Economic Zone and Fishery Zones. (FAO, 2015).

On the whole, movement in space is essential to the fisher's adaptive capacity, allowing him/her to both pursue fishing stocks and mitigate weather conditions. Yet it is not always as simple as simply choosing a different location. Indeed, the fishers are quite agile in their pursuit of fish stocks, but the landing facilities where they unload their catch are not, a fact that must be reckoned with no matter how lucrative the fishing may be further afield. Another limitation is that fishing vessels consume a great deal of fuel, and the further afield they voyage the greater their operating costs. Finally, the further out to sea they fare, the more vulnerable they are to storms and waves, and the higher their insurance costs (Hovelsrud & Smit 2010: 35).

Historically, coastal fishers in the region were also terrestrial farmers and pastoralists (*fiskarbonden*) in order to ensure year-round income. This practice has become

virtually non-existent, however, due to changes in the national income tax system which restricts and penalizes those with multiple sources of income (Hovelsrud & Smit 2010: 45).

Herding and fishing have been the backbone of Finnmark's economy for the bulk of its history and have long-held claims upon its spaces. Though there are some historical accounts of fighting between the Norse and Saami, their territorial requirements of sea *versus* land respectively did not likely necessitate conflict. Perhaps Fisher-Farmers' pastoralism conflicted with the reindeer herders, and the Sea-Saami's fishing in turn conflicted with the Norse fishers. Whatever the case, while the different ethnic people's territories may have overlapped, their livelihoods were arguably not at cross-purposes, and while their combined economic output may not have been extravagant, it provided sustainable yields for communities spanning the course of several thousands of years. Such is no longer the case in modern Finnmark. The last 50 years has witnessed the arrival of two new, lucrative and powerful industries which have challenged Finnmark's territorial *status quo.*

Mining and LNG Territorial Adaptive Strategies

The mining and LNG industries have a degree of nomadism in common with their fellow fisher and reindeer herder as they follow their respective resources. Indeed, the long-term economic viability and adaptability of the LNG and mining industries are equally dependent upon their ability to maneuver in space. The similarities, however, stop here. For while fishers and reindeer herders harvest renewable resources based on principles of sustainable yield, the mining and LNG industries extract non-renewable resources based on principles of maximum yield. This requires them to pick up and move on to the next space containing their resource where it can be extracted for the right price, wherever it may be on the globe, again and again and again. Theirs is a territory which requires continual migration into new spaces as the old ones become used up or less profitable. Maps are redrawn and red-tape is removed, new petroleum exploration blocks are opened and mining concessions approved in order to accommodate these GDP heavyweights (NPI 2011).

5.3.1 Territory and Conflict

The constant movement of the LNG and mining industries will inevitably conflict with established local industries' territory, as is clearly the case in Finnmark. The newcomers' arrival not only implies loss of territory for the traditional industries, but risks significant degradation of the ecosystems which they are entirely dependent upon. For example, the proposed Nussir underground mine and submarine tailings deposit might somewhat appease the Saami by not degrading the surrounding pasture, but they may nonetheless need to find a new migration corridor altogether to avoid the activity surrounding the site. Meanwhile its chemical and uranium laced tailings would likely remove Repparfjord from local fishers' adaptation repertoire and risks degrading the local wild salmon stock which spawn here.

The LNG processing plant Snøhvit was shrewdly placed on the small island Melkøya, which is not used for reindeer pasture. Yet emissions of black soot from flaring and the infrastructure being built elsewhere on Kvaløya (the larger island Hammerfest is situated upon) to service the facility have resulted in degradation and reduction in the local grazing. Similarly while it was considerate that the undersea pipeline was constructed in a manner which allows fishing boats to trawl in the region without risking their nets becoming caught, the facility introduces a risk to the region's fish stocks should an accident occur. As the most northerly off-shore gas field in the world, the environmental conditions here create exceptional risk as Statoil themselves observes on their Snøhvit website: "Winds, freezing temperatures and turbulent seas make extreme demands of those intending to function and survive here, whether it is the region's flora and fauna, traditional industry or oil and gas operations" (Statoil 2015). Fortunately, the Snøhvit installation is on the seabed where "all is peaceful," unaffected by surface conditions (*ibid*). This may be true, but their nearby offshore oil platform 'Goliat'[54] is expected to begin production during the year of this writing. As the most northerly oil platform in the world and first to operate in the Barents Sea, its operation and oil tankers will be exposed to the very same "winds, freezing temperatures and turbulent seas" which make "extreme demands of those intending to function...here" which Snøhvit evades. There are stories here of rescue boats needing rescue when a

[54] In partnership with the Italian firm ENI, who has the majority share.

surprise "polar low" strikes, how will a sluggish oil tanker fare in these conditions? The Deepwater Horizon oil spill discharged 4.9 million barrels of oil - roughly what the whole of Norway extracts in 4 days[55] - into the Gulf of Mexico. It took 87 days to stop the spill, in a region with much more agreeable climatic conditions and nearby, advanced infrastructure to aid in the clean up effort. Clean up efforts following an accident in the Arctic would be tremendously complicated due to the extreme climatic conditions, darkness and ice-cover during the winter months, as well as logistical issues of getting supplies to this remote location. If a disaster of the scale of the Deepwater Horizon can occur in such benign conditions less than a decade ago, perhaps the industry is not prepared to take on the Arctic. Finally, the oil and gas industries produce substantial amounts of GHG both in the production and the consumption stages, and as such contributes to the global warming and ocean acidification which the traditional industries are particularly vulnerable to.

Territorial Conflict and Adaptation

The traditional industries of fishing and reindeer herding have been identified as the most vulnerable to climate change and mining and LNG as the least. If the former are hit and hit hard by changing environmental conditions, Hammerfest's future resilience may well depend upon a broad range of more resilient industries. Perhaps mining and LNG are their best bet. Yet one must remember that the timeframes of these resource extraction operations are relatively short. The proposed Nussir mine, for example, is expected to be in production roughly 30 years, Snøhvit another 25 years, and Goliath is expected to last no more than 10-15 years. Other dramatic mineral and petroleum discoveries notwithstanding, these are not long term adaptation strategies for sustained multi-generational economic growth, let alone good careers for current generations to retire on. Moreover, given the risks they represent to the region's renewable resources and their contributions to global climate change, their introduction in Hammerfest may best be described as maladaptation, not adaptive capacity builders.

[55] Based on US Department of Energy (2014) which lists Norway's annual production at 1, 539, 000 bbl/day.

Historically, the keys to fishers' success in response to shifting economic and environmental conditions were their ability to adapt by fishing different species or by fishing in different spaces. Indeed, this is seen as the strategy that brought fishers through the cod collapse of the 1980's (Hovelsrud & Smit 2010: 35). Climate change's effects on distribution and abundance of fish stocks are likely to be significant and will put these strategies to the test. But the efficacy of these strategies will be drastically reduced should their territory become degraded through an accident or reduced by intent, increasing their vulnerability even more.

Similarly the reindeer herder's success in adapting to climate variation is determined by their 'freedom to move,' that is, their ability to make use of the different qualities of a diverse landscape (Tyler et al. 2007: 197). Indeed, the herders require and have access to more territory than any of the other terrestrial industries - a fact which many respondents in this sample seemed to misunderstand and resent. Roughly 40% of mainland Norway is designated for reindeer pasture where herders can, at least in theory, graze their herds (Tyler et al. 2007: 199). Even so, the reindeer herder has good reason to fight intrusion into their territory: according to the herder respondents, what many do not understand is that the problem of a new road, power line, or hut in their grazing land does not lie in the areal reduction in forage below these developments. The real problem is that these 'tame' reindeer are extraordinarily skittish, and will avoid an area surrounding the intrusion by sometimes several kilometers. The herder's right to grazing over nearly half of Norway's land is not an exclusive right; therefore, other land users' interests may also be realized in these spaces. A handful of cabins may be enough to scare a herd out of an entire valley, and a power line can divide an island as effectively as an electric fence. Within the last 50 years it is estimated that up to 35% of the Finnmark's coastal reindeer range has fallen into disuse due to herd avoidance of infrastructure, and this number is projected to reach 78% by 2050 (Jernsletten and Klokov 2002, UNEP 2004, as cited in Tyler et al. 2007: 199). In saying no to development, the herders are not simply being obstinate; the preservation of rangeland is essential to the industry's future, a future which becomes less and less certain with every road and cabin built.

5.3.2 **T**erritory and Cooperation

As long as Finnmark's economy remains dependent on natural resources it will remain vulnerable to fluxes in these resources and global demand for them (Hovelsrud & Smit 2010). This vulnerability increases when the territorial needs of its key resource-based industries conflict, as their adaptive capacity to meet changes in climate and economic swings will be compromised by restricted or degraded space. On the other hand, while granting one industry primacy over a territory would allow this industry to employ the full range of spatial adaptive strategies, it would also exclude other actors and risk increasing overall vulnerability inherent to a homogenized local economy.

Clearly everyone cannot have their cake and eat it too, but not all industries in Hammerfest are inherently conflictual. Non-conflictual - and even synergistic land-use - can and does occur in Hammerfest. A trio has been identified repeatedly throughout this research as containing similar traits, and has the potential to mutually strengthen one another's adaptive capacities: fisheries, herders and tourism. Fishers manage one of the most productive fisheries in the world and sell meat of the highest quality. Herders require that wilderness remain untouched to support their herds. Tourism promotes the purity of North as one of the last true wildernesses. Though conflicts may sometimes emerge, these industries have more in common than that which divides them: namely that their territories remain uncontaminated. Indeed, tourism respondents had much to say about the herders' demands on land during the summer months, yet had found ways of abiding by the herders needs by changing the location of their tours. Though certainly a source of irritation on both parts, there is no fundamental, unsurmountable challenge or risk implied by the two industries sharing the same spaces.

In this regard, mining and LNG are quite simply the odd ones out. They are by far the more lucrative endeavors in the short term, yet represent unprecedented risks and territory loss for the other three industries which present no such risk or loss to the newly arrived LNG and mining industries in return. On the other hand, LNG and mining themselves present another possible partnership which is far less vulnerable to climate change and whose territory needs are not inherently conflictual. This combination of substantial economic benefits and limited environmental vulnerability would clearly make them attractive options for policy makers seeking to ensure that Hammerfest continues to flourish in an uncertain future.

Yet the question of fairness arises as the traditional industries are held to strict regulations based on principles of sustainability yet face risks to and loss of territory on account of industries that are not governed by the same principle. Whereas fishers receive fines for dumping waste in the ocean, regulatory bodies regularly turn a blind eye to similar or worse practices in the LNG and mining industries, opting instead to favor job creation and economic growth[56]. If fishers are forced by law to respect the common resource of the sea, the simultaneous allowance of other industries to pollute the ecosystem upon which fishers depend represents an injustice. This is not only a question of fairness at the local scale, but the global as well. The waste products of both LNG and mining enter the commons of sea and air, thus increasing the exposure of communities across the world to environmental change.

Above it was argued that the adaptive capacity of all industries in this sample depend upon access to and movement within space, and that this capacity is reduced when the territories of industries conflict. In this regards the promotion of non-conflictual and cooperative territory use may be seen as building adaptive capacity. If territorial cooperation is to be achieved, clearly all actors operating within the same space must adhere to basic principles regarding its use. I contend that such cooperation currently exists between the tourism, fisheries and herder industries, and that non-conflict is possible between the LNG and mining industries. Yet these two blocks entail very different activities with regards to their use of territory which result in conflict. Though it is beyond the scope of this research to explore further, I suggest that conflict is in part the result of different principles being applied to different industries. Guiding principles are necessary to ensure fairness, optimal adaptation ability to changing economic and environmental conditions and continued economic use. This is clearly not the case in Hammerfest today.

This concludes chapter 5, which has examined the climate change adaptation implications of perception, identity and territory in Hammerfest. It is important to note

[56] The recent example of Nordic mining's proposal, where the Ministry of Environment went against the advice of its own expert panel and approved the planned STD. The grounds for this decision was that the benefits of 500 jobs outweighed the risks of dumping millions of tonnes of toxic waste in Fordefjord, home to whales and porpoises and one of Norway's most important cod and salmon spawning grounds (Grønskar 2015).

that the majority of participants stated, irrespective of the degree to which their industry was dependent upon environmental stability, that their greatest vulnerability is to the social world and the swings of the global economy in particular, and not climate change. This is also a common finding in other adaptation studies (i.e. Amundsen 2014, Kelman 2014). Once again, these may be seen as early days in terms of what climate change has in store and the balance of concern may yet shift as the environmental movement gains more and more momentum. For the time being, however, climate change is not at the forefront of the minds of the respondents in this study, a fact which does not bode well for efforts to curb climate change as the majority of the world currently remain much further removed from its most dramatic impacts.

6 Conclusion

The primary question this research set out to answer was whether or not individuals in climate change hotspots perceived the changes identified through scientific observation, and if so, how they were responding. In addition, it sought to identify other social enablers and limitations to their adaptive responses. Based upon the findings gathered in one such hotspot, Hammerfest, I have constructed the argument that adaptation efforts, both to current and anticipated changes, may be complicated within the case study area by three social factors.

Firstly, there is a distinct difference between industries with regards to the degree and nature of perceptions of environmental changes and subsequent action, whereby respondents from traditional industries were more likely to have experienced environmental changes first hand and adapted in reaction, while those in resource extraction industries had only knowledge of these changes and had implemented anticipatory adaptations. The two types of perception, analytical and experiential were identified as a result and it was subsequently argued that they act as both enablers and limitations on adaptation, and that a combination of the two forms provides the ideal knowledge base with which to inform adaptations.

Secondly, identities relating to livelihoods were found to be differential between industries, whereby respondents in traditional industries were far more likely to identify with their livelihoods than respondents in the tourism, LNG and mining industries. The link proposed in other adaptation research between identity, vulnerability and engagement was explored and was found to be partially supported by the findings of this research. It was then contended that engagement may come in the form of conservation, and that conservation and adaptation are not one and the same and may have negative implications for the community's adaptive capacity. Thus, these strong and weak identities may both limit and enable adaptation to environmental change.

Finally, I contended that Finnmark's space is divided into overlapping territories that are contested by the various industries which depend upon it. As all industries in this sample employ adaptive strategies in space, territory conflict, loss, and/or degradation will limit adaptation possibilities. Cooperation based upon common guiding principles

was argued as the key to encouraging optimum adaptive capacity in shared spaces, though this seems to not be consistently practiced in Hammerfest at present.

Thus, in response to the research question, I have found support for the argument that inhabitants of Hammerfest employed in the primary sector are indeed perceiving and acting upon many of the environmental changes identified through scientific observation such as that found in the NPI report (2011). Moreover, the different natures of experiential and analytical perception, livelihood identities, and territorial relations were argued to be significant social enablers and limitations to adaptation efforts.

Hammerfest may have a high degree of adaptive capacity relative other Arctic communities on account of its wealth of human and financial capital. Yet vulnerability is a contingent concept, and focus on 'objective' parameters alone may mask the vulnerability of those individuals who are most vulnerable to climate change (Obrien et al. 2006). In this regard, it is not a question of whether or not Hammerfest is prepared for climate change, but of which parties within Hammerfest are.

While endeavoring to answer the research questions, many additional questions arose along the way which require further research. With respect to perception, I identified respondents in the fisheries and herder industries as the most perceptive, with access to daily personal experience, rich traditional ecological knowledge, and scientific observations. Yet these are the two industries most vulnerable to environmental change, and are in addition struggling to recruit youth to take the place of an aging workforce. These two factors may result in a dramatic reduction in these expert perceivers and their adaptive knowledge at a time when their communities may need them most. The collection and incorporation of their unwritten TEK into mainstream adaptation research and policies is therefore a matter of urgency, though it remains to be seen whether or not TEK will continue to serve as a reliable reference as environmental and social conditions represent unprecedented challenges. In addition, I argued that the combination of experiential and analytical perception could provide the ideal knowledge base and motivation to adapt. Efforts to direct individuals' experiential perception to changes occurring around them supplemented with analytical information regarding these changes may therefore have significant effects in terms of mobilizing individuals to engage in anticipatory adaptive and mitigative behavior.

With regards to identity, respondents from the tourism, LNG and mining industries were argued to have the weakest identification with their livelihoods and place. As such I contend that they are more flexible in responding to change compared to fishers and herders. However, in their flexibility these same respondents suggested that they would simply change employment and move if their industries struggled to cope with environmental changes. While these industries certainly add to the coffers of Hammerfest in the present, their contribution to building lasting adaptive capacity may prove an illusion in the future as they may be the first to abandon ship when the going gets tough. In any case, LNG and mining are by nature short-term endeavors, ones which will move on when the resource is extracted or becomes unprofitable. Meanwhile the fisheries and herder industries have endured for thousands of years and can potentially continue for thousands more. Respondents from these industries were identified as having the strongest attachment to both livelihood and place, and would presumably prefer to endure harsh environmental or economic conditions instead of move or change employment. Yet these are the most vulnerable industries to the projected changes and these respondents may soon be forced to reevaluate their livelihood prospects. In this regard, alternatives are best found sooner than later. Fish farming is one possible alternative, one that can be moved to land if the oceans become too warm or acidic. Feeding reindeer herds with hay or pellets is another alternative to the current migration strategy employed by the herders, though a potentially cost-prohibitive one. Nonetheless, in finding alternatives to these most vulnerable industries one must consider that it is possibly not simply the fish and reindeer that these workers identify with, but instead the multiple layers of meaning that their livelihoods entail and the implications these may have on their sense of identity.

Finally with regards to territory, more research is required on several points. At the macro-scale, the potential implications of climate change on international territorial conflicts has received growing attention,[57] and at the micro-scale adaptation research has explored the use of movement in space as an adaptive strategy.[58] In addition, substantial literature already exists surrounding the social construct of "land and

[57] e.g. New York Times 2014.

[58] e.g. Tyler et al 2007.

seascape" as sentimental attachments. Yet following an extensive literature review, territorial conflict at the meso-scale identified in this thesis appears to be altogether absent. Discussions surrounding climate change's impacts on the spaces we value could be enriched by the inclusion of the concept of "territory" as a fundamental dependency upon these same spaces. Spatial dimensions and the socially constructed territories that divide them are crucial elements to many industries' ability to adapt to climate change, and as economies and populations grow these spaces will become all the more contested. If territories are conflicting in the vast open spaces of Finnmark, how will industries in the more congested regions to the south fare when conditions require that they either move or succumb to climate change?

In the introduction it was said that society lacks an instruction manual to face the challenge of climate change. Indeed, it is not a given how adaptation will or ought to proceed. Species have come and gone, new lands have been claimed and others abandoned, and livelihoods have risen and fallen, all to the ebbs and flows of opportunity and calamity. As described earlier, inhabitants of northern Norway have been adapting for millennia, and pride themselves on their ability to endure whatever conditions nature throws at them. This confidence and defiance is ingrained in their common expression "we stand tall in the face of storms" (*Vi står han av*).[59]

There is certainly good reason to be optimistic when facing these changes as our knowledge and technical capacity have never been greater. Yet then again, we are situated in a complex, unproven globalized economy supporting an immensely large human population in the midst of one of the Earth's greatest species mass-extinction events, hurtling with unprecedented speed into a climate never before experienced in human history. It would be an understatement to say that this will entail a few novel challenges. Though undoubtedly useful, human history cannot be our only guide.

What of the future then? We have models that can definitively say what is 'very likely' to happen in 50-100 years' time. Can we not simply prepare for these likely events? While preparation is indeed wise, scientific modelling cannot sufficiently predict how humans in changing social milieu will interact with the changing environment and the feedbacks these interactions will entail, nor what types of technologies and policies will

[59] As cited in Hovelsrud & Smit 2010: 36.

be developed in the future. In other words even if we were to achieve the impossible and include every environmental variable into a predictive model, unpredictable humans would most certainly invalidate its results.

Our past cannot be our guide in the face of novel change, and climate modelling is not our crystal ball into the future. That leaves the present. Hotspots are currently experiencing today what other communities will face tomorrow; their experiences may be our best insight into how social worlds fare when their environments undergo dramatic change. Perhaps the instruction manual we need is best written one page at a time as one community after another enters completely unchartered waters.

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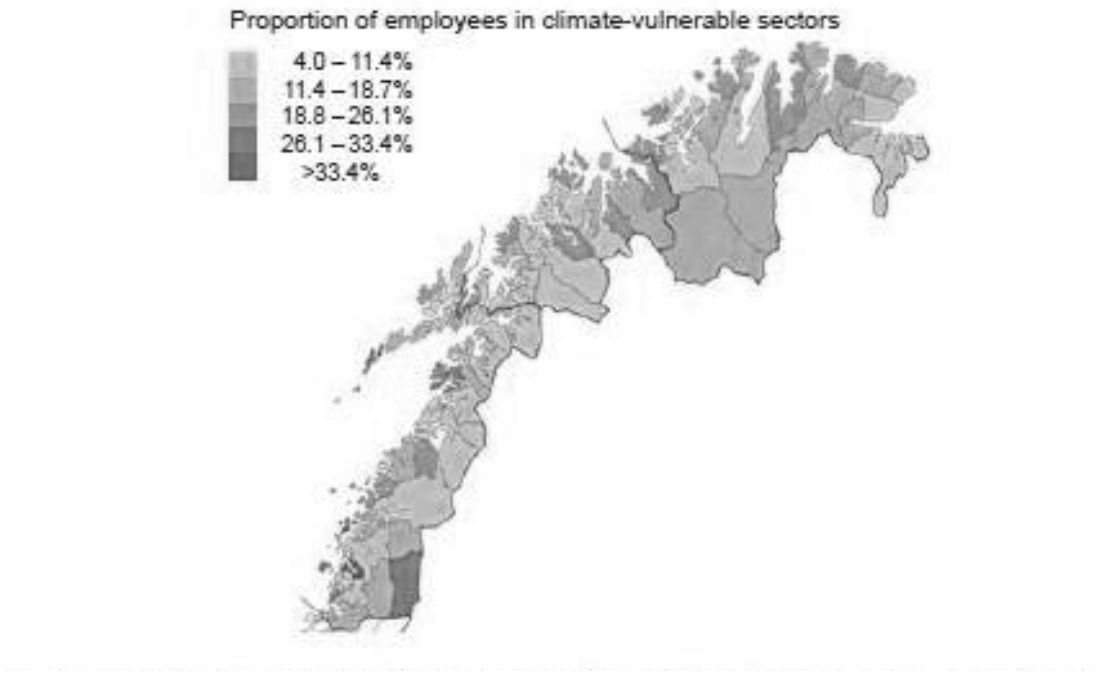
Appendix

	2013
	Sysselsatte personer, etter bosted
20 Finnmark Finnmárku	
01-03 Jordbruk, skogbruk og fiske (incl. reindeer)	2 463
05-09 Bergverksdrift og utvinning (incl. Oil and Gas)	1 175
10-33 Industri	2 281
35-39 Elektrisitet, vann og renovasjon	664
41-43 Bygge- og anleggsvirksomhet	3 114
45-47 Varehandel, reparasjon av motorvogner	4 518
49-53 Transport og lagring	2 369
55-56 Overnattings- og serveringsvirksomhet	1 315
58-63 Informasjon og kommunikasjon	625
64-66 Finansiering og forsikring	225
68-75 Teknisk tjenesteyting, eiendomsdrift	1 231
77-82 Forretningsmessig tjenesteyting	1 555
84 Off.adm., forsvar, sosialforsikring	3 738
85 Undervisning	3 647
86-88 Helse- og sosialtjenester	8 057
90-99 Personlig tjenesteyting	1 268

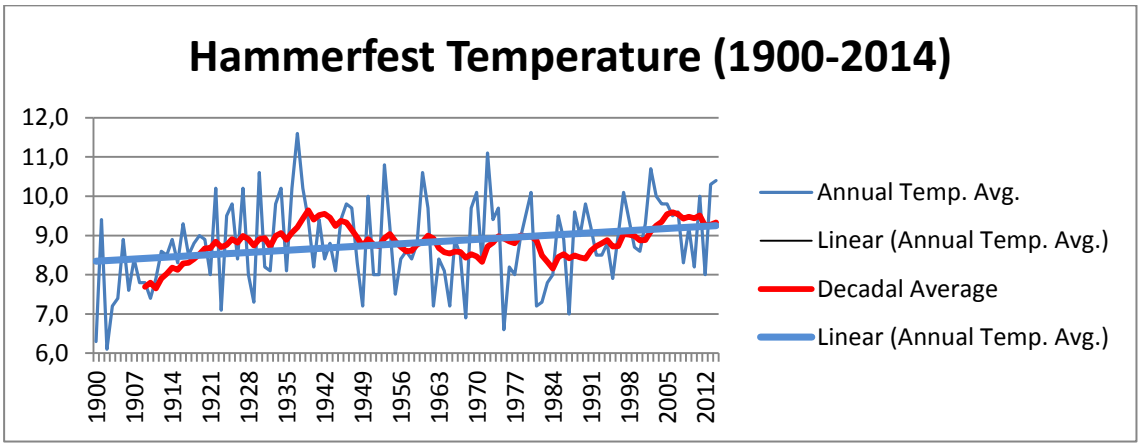
Appendix 1 - Finnmark Employment (Source: SSB). Highlighted segments are from top to bottom 01-03 Farming, Forestry, Fishing and Herding; 05-09 Mining, Oil and Gas and 55-56 Accomodation and Serving. Used to identify segment of population working in the industries used in this study.

	2013
	Sysselsatte personer, etter bosted
2004 Hammerfest	
01-03 Jordbruk, skogbruk og fiske	202
05-09 Bergverksdrift og utvinning	482
10-33 Industri	390
35-39 Elektrisitet, vann og renovasjon	112
41-43 Bygge- og anleggsvirksomhet	389
45-47 Varehandel, reparasjon av motorvogner	587
49-53 Transport og lagring	427
55-56 Overnattings- og serveringsvirksomhet	205
58-63 Informasjon og kommunikasjon	60
64-66 Finansiering og forsikring	48
68-75 Teknisk tjenesteyting, eiendomsdrift	170
77-82 Forretningsmessig tjenesteyting	260
84 Off.adm., forsvar, sosialforsikring	354
85 Undervisning	447
86-88 Helse- og sosialtjenester	1 386
90-99 Personlig tjenesteyting	178
00 Uoppgitt	7

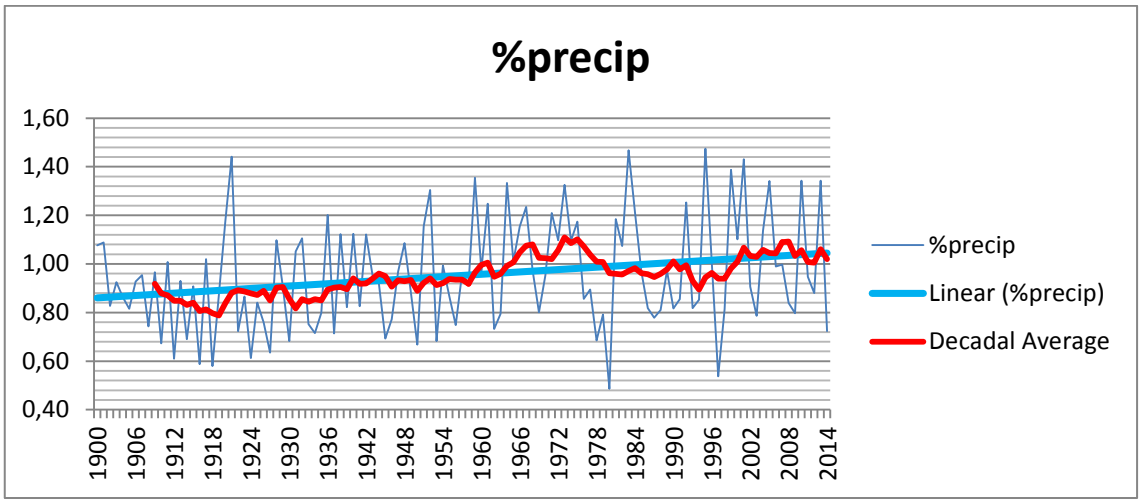
Appendix 2 - Hammerfest Employment (Source: SSB). See Appendix 1 comments.



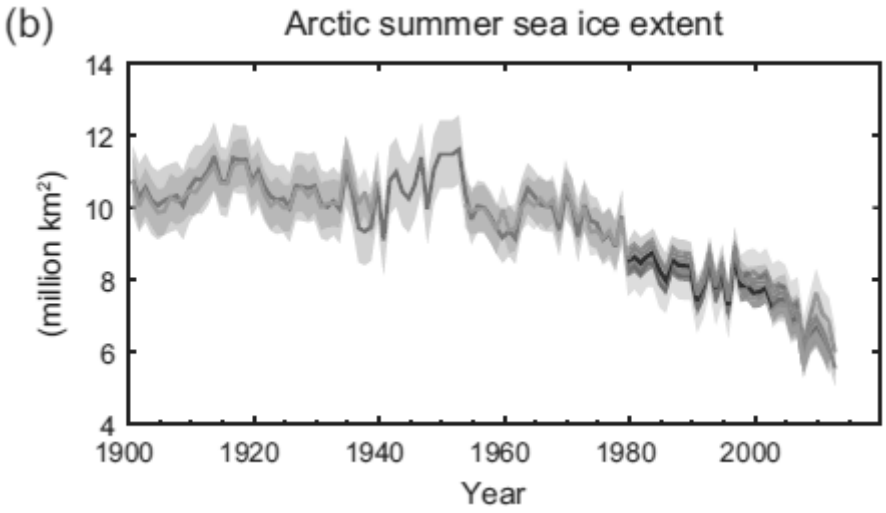
Appendix 3 - Proportion of employees in climate-vulnerable sectors in Northern Norway. 'Climate vulnerabilities are measured here based on a number of indicators, for example exposure to avalanches and floods, and an evaluation of the industry's climate vulnerability, infrastructure and the competence, economy and population composition of the municipality.' District of Hammerfest is within the 18.8 – 26.1% range. (Source: Groven et al. 2006)



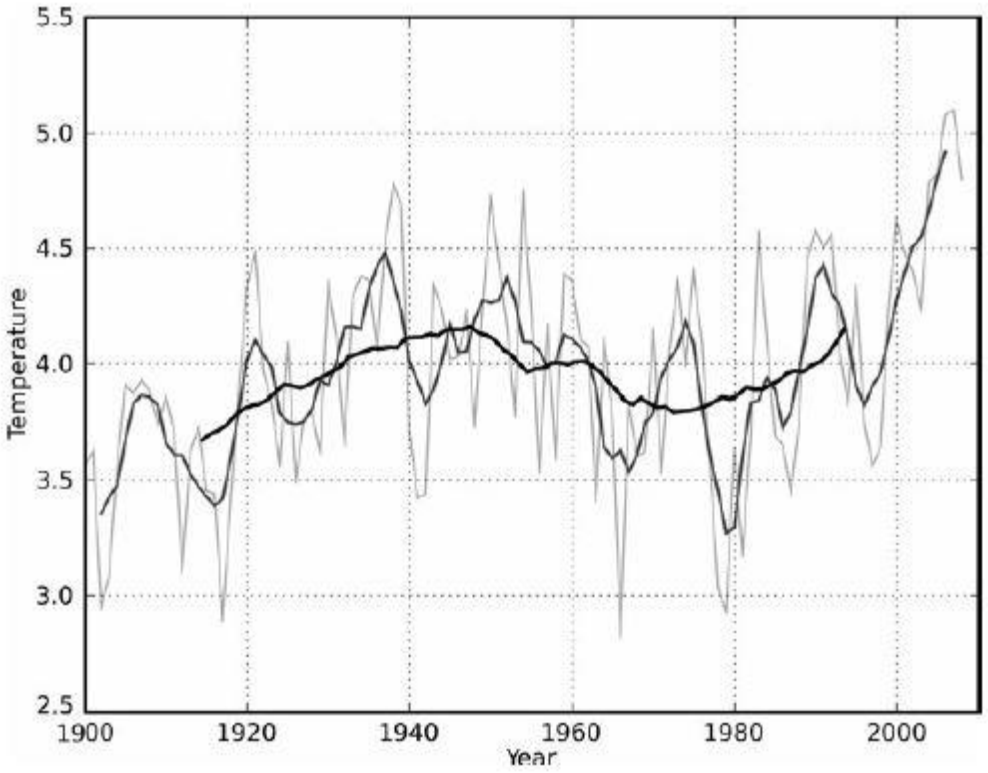
Appendix 4 - Hammerfest Temperature 1900-2014 (Source: yr.no)



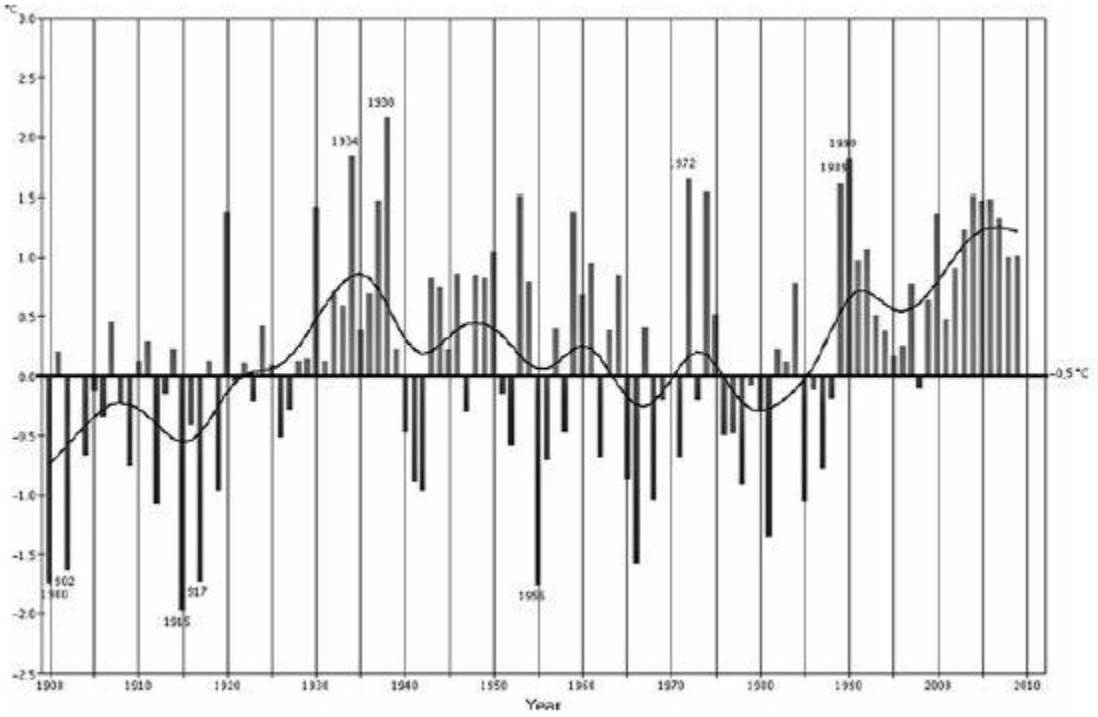
Appendix 5 - Hammerfest Precipitation 1900-2014 (Source: yr.no)



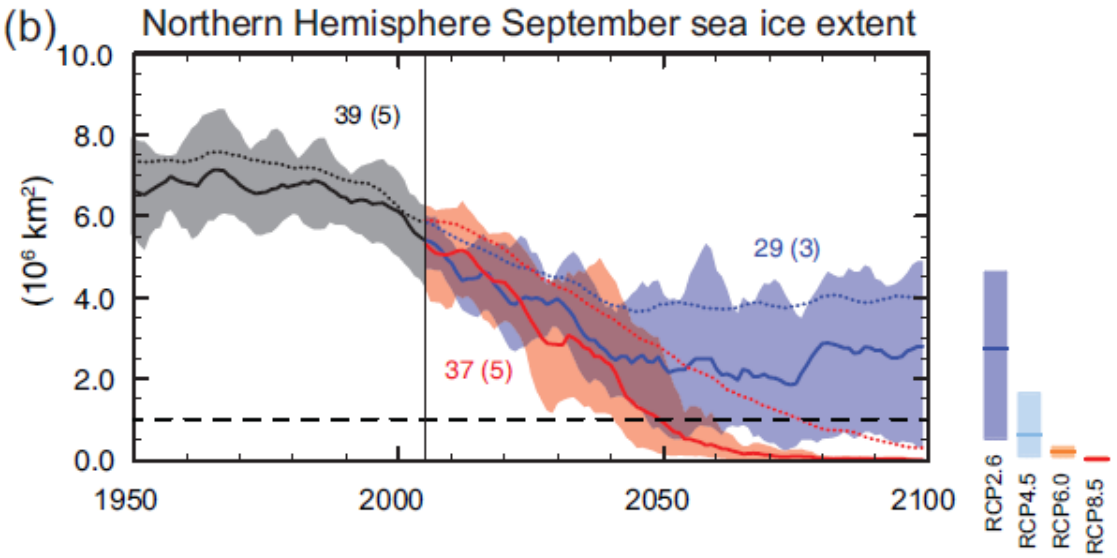
Appendix 6 - Arctic Summer Sea Ice Extent 1900-2013 (Source: IPCC, 2013)



Appendix 7 - Barents Sea Temperature 1900-2010. 'Ocean temperature development in the easter Barents sea in the 20th century. Data from PINRO, Murmansk. (Source: Bjørn Ådlandsvik, Insitute for Marine Research, Norway)



Appendix 8 - Northern Norway Temperature 1900-2010. (Source: Norwegian Meteorological Institute).



Appendix 9 - Summer Sea Ice Extent Projections to 2100 (IPCC, 2013)

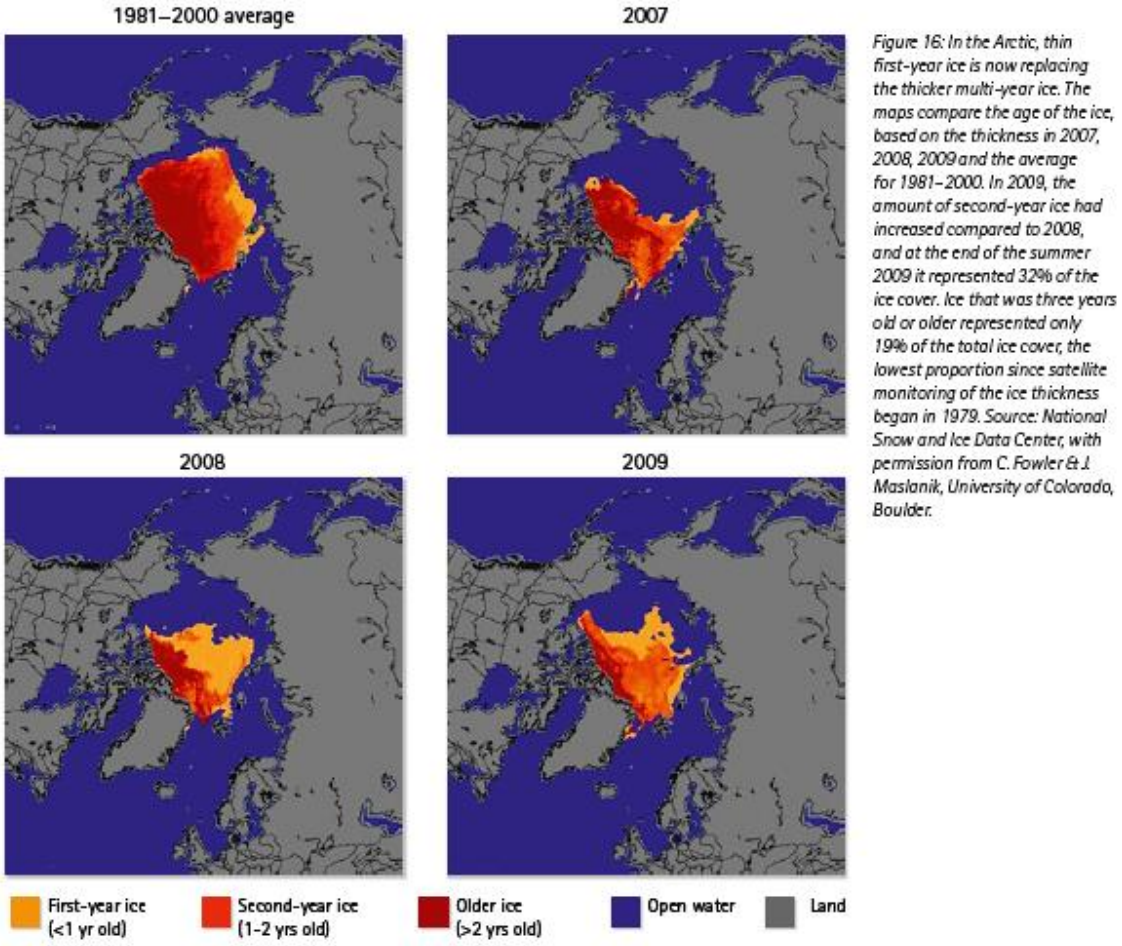
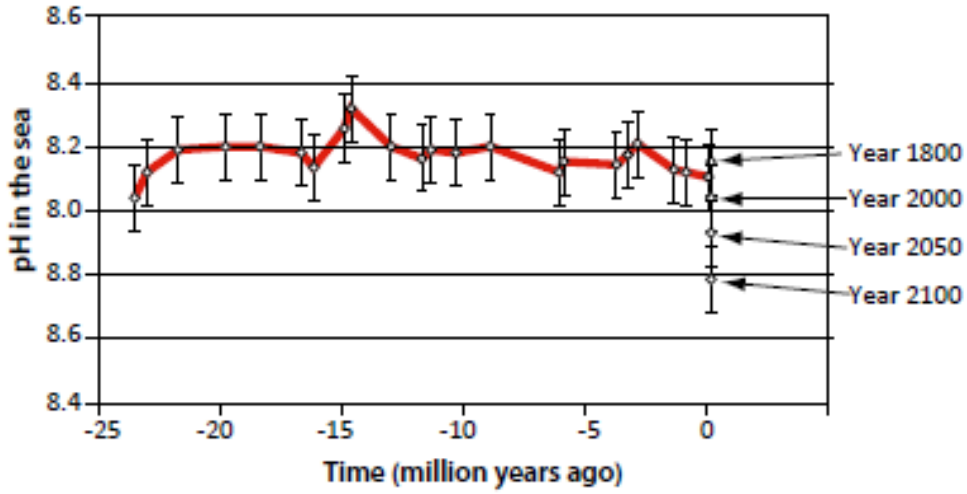


Figure 16: In the Arctic, thin first-year ice is now replacing the thicker multi-year ice. The maps compare the age of the ice, based on the thickness in 2007, 2008, 2009 and the average for 1981–2000. In 2009, the amount of second-year ice had increased compared to 2008, and at the end of the summer 2009 it represented 32% of the ice cover. Ice that was three years old or older represented only 19% of the total ice cover, the lowest proportion since satellite monitoring of the ice thickness began in 1979. Source: National Snow and Ice Data Center, with permission from C. Fowler & J. Maslanik, University of Colorado, Boulder.

Appendix 10 - Arctic sea ice age and area

Appendix 11 - Expected changes in the distribution of fish species. (Source: AMAP 2003)



Appendix 12 - Ocean pH during last 25 million years. (Source: Blackford & Gilbert 2007, modified according to Pearson & Palmer 2000)

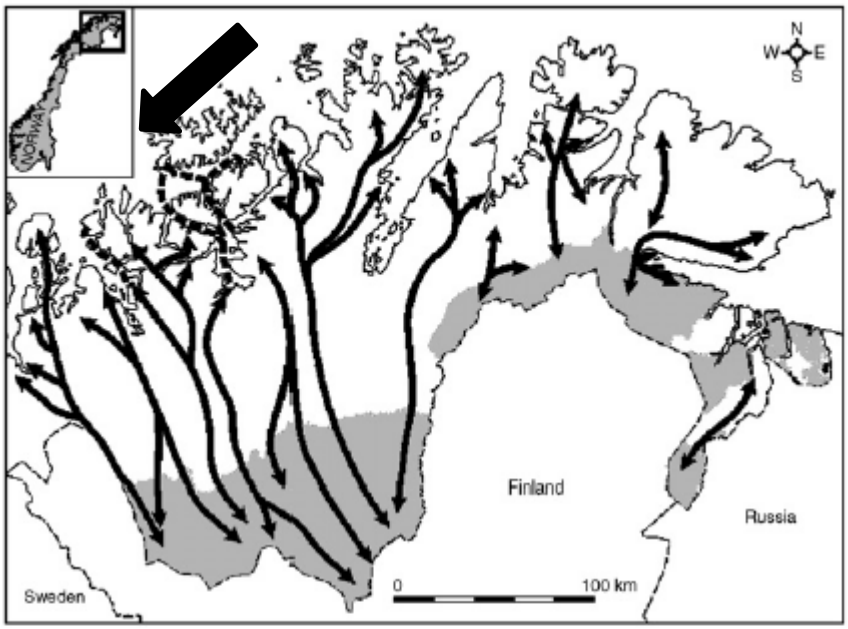


Fig. 3. The general pattern of migration of semi-domesticated reindeer in Finnmark. Herders here typically make two migrations with their animals each year, moving between geographically separate summer and winter pastures. In spring (April and May), they and their animals generally move to the mountainous coastal region where the reindeer are left on peninsulas or are swum or ferried across to islands where they feed throughout the summer, eating highly nutritious parts of dwarf shrubs, birch, willows, sedges and grasses. In September they are typically gathered and taken inland to winter pastures (shaded grey) characterized by open, upland plains of tundra and taiga birch scrub. For clarity, only a selection of migration routes (black arrows) and ferry routes (heavy dotted lines) are shown.

Appendix 13 - Finnmark Reindeer Migration (Source: Tyler et al. 2007) [Arrow pointing to Hammerfest inserted by author]